ENGINEERING NEWS-RECORD

JANUARY 27, 1944

Finishing Our Road to Alaska • An Engineer at Work in Ecuador

Concrete Reservoir Costs • Timber Bridge Reconstruction

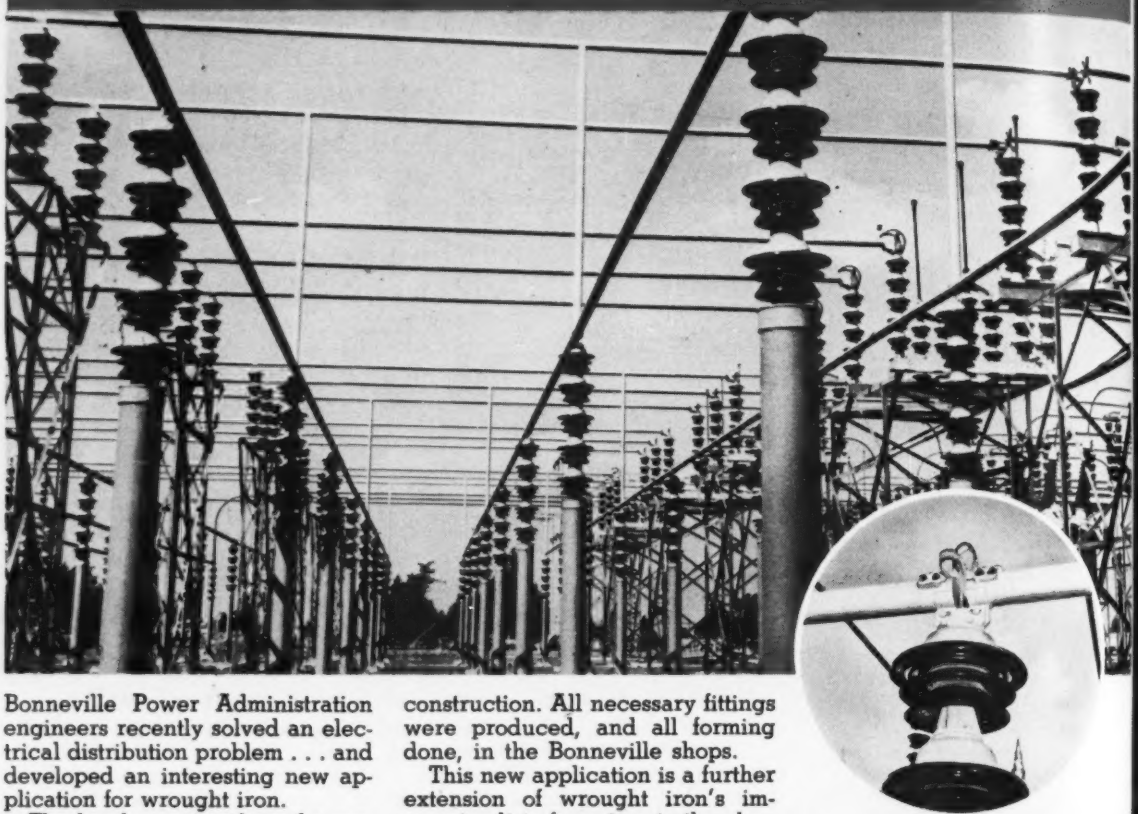
ALSO IN THIS ISSUE

SPECIAL SECTION ON PLANNING FOR POSTWAR HIGHWAYS

Engineering ingenuity—and

GENUINE WROUGHT IRON

solved this electrical distribution problem



Bonneville Power Administration engineers recently solved an electrical distribution problem . . . and developed an interesting new application for wrought iron.

The bus-bar network in the system substations would have required a prohibitive amount of the non-ferrous metals ordinarily used, and so alternates were carefully investigated. The material found to possess the most desirable combination of strength, conductivity, corrosion resistance, ease of fabrication, simplicity and economy, was wrought iron. Furthermore, the engineer's report cited several points in its favor for use in *permanent* buses: carrying capacities at 115kv and 230kv sufficient to handle current from the largest stations . . . physical properties that permit the use of long spans . . . good corrosion resisting qualities in moist atmospheres . . . lower cost . . . less expansion, and so fewer expansion joints . . . easy, quick and economical welding . . . and adaptability to "streamlined" construction. All necessary fittings were produced, and all forming done, in the Bonneville shops.

This new application is a further extension of wrought iron's impressive list of services to the electrical field. Widely used as heavy-wall conduit, to protect electrical cables in river and bridge crossings and underground runs, it is also serving in transformer cooling coils and cases; in switch boxes installed in corrosive surroundings; in electrodes in salt annealing furnaces; precipitation plates for carbon production; in ground and lightning rods, and lightning masts; and for generator housings, stator yokes on aircraft amplidynes, and motor generator frames. In each case, the application was initiated by the engineer involved, based on his knowledge of wrought iron's characteristics.

Perhaps Byers Wrought Iron can help you solve some electrical problem. In any event, it can serve you in some capacity. To get a picture of the many jobs wrought iron is doing . . . and some ideas as to where it might save for you . . . ask for our bulletin, "101 Uses for Wrought Iron."

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ENGINEERING NEWS-RECORD

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Vol. 132 JANUARY 27, 1944 No. 4

COMING NEXT

• Disregarding the usual procedure of relocating heavy boilers by demolition and re-erection, engineers in cooperation with the boiler manufacturer moved a 750-ton unit intact recently without cracking the plates or springing the water tubes. The method used, which will be described in *ENR* for Feb. 10, resulted in a saving of four months time and $75,000 over that estimated for doing the job in the usual manner.

• Fighting "Ole Man River," during a flood not exceeded in intensity for nearly 100 years, to complete erection of the 3,627-ft. span across the Mississippi below St. Louis called for the utmost in resourcefulness and ingenuity on the part of the contractors. Problems seldom experienced were successfully overcome, and the methods employed are of exceptional interest. The project, design and construction, will be described in the Feb. 10 issue.

• Among a variety of other subjects to be featured in the Feb. 10 issue, will be the work of the U. S. Engineers in building Norfork Dam. Oklahoma's experience in constructing a divided access highway; an analytical exposition of cross hair adjustments of surveying instruments; and how Seattle increased traffic flow by removing abandoned street railway rails.

REVIEW NUMBER

• February 24 is the date of *News-Record's* Annual Review and Forecast Number, and because of the rapid changes and confusing developments to which civil engineering and construction have been subjected, the issue has been planned with particular care.

As befits a war year, the activities and accomplishments abroad of the engineers and construction men in the Army, Navy and Marines are given prominent attention. Likewise on the homefront, war-induced problems, such as those of postwar planning, engineering education and construction equipment supply have been singled out for emphasis.

The reviews of developments in the various fields of engineering and construction will also be included, as will the annual statistical review, which will encompass data on jobs proposed for postwar construction.

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CONCRETE HIGHWAY NEWS
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SCALE RESISTANCE PROVED BY FOUR MINNEAPOLIS WINTERS

ATLAS DURAPLASTIC*

Air-entraining Portland Cement on city pavements confirms original tests and research

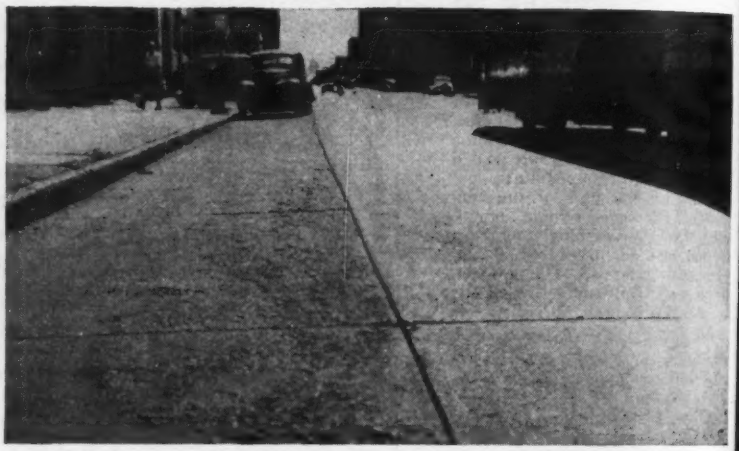

Photo of Second Avenue North, Minneapolis, taken in 1943. Left lane was laid with normal portland cement in 1939: right lane was laid at the same time with Atlas Duraplastic cement. Four winters of identical salt de-icing treatments produced the results shown.

Minneapolis, Milwaukee, Illinois, Ohio and other states and cities have found that concrete streets and highways made with air-entraining portland cement are highly scale-resistant under both alternate freezing and thawing and repeated applications of salt de-icing treatment. Some of these, like the installation pictured above, are now in their fifth winter and all are practically scale-free.

For further information on Atlas Duraplastic—a development of over six years of research and tests by Universal Atlas in the laboratory, in the plant and on the job, write to our Technical Service Bureau. Ask for reprints from trade and technical magazines on the original research and on actual installations.

Quick Facts about Atlas Duraplastic

1. Complies with current Federal and ASTM specifications.
2. Renders concrete pavements highly resistant to scaling due to the action of salts used for ice removal.
3. Protects concrete against the effects of freezing and thawing weather.
4. Minimizes segregation and bleeding. Concrete is more uniform throughout and more durable.
5. Permits earlier finishing.
6. Requires no additional material at the mixer.
7. Called *Duraplastic* because it makes concrete more *durable* and more *plastic*.

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NIGHT DRIVING MADE SAFER

—with White Concrete Reflecting Curb

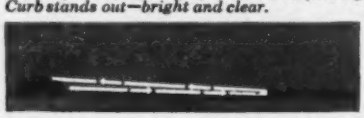
For greatest visibility, under headlights alone, it is not enough that curb be white and a good reflector. It must reflect light in the right direction—back to the driver. The diagrams below show why.

Scientifically designed faces on a Reflecting Curb made with Atlas White cement catch headlight rays and reflect them back—right to the driver's eyes. Thus the curb stands out—clearly visible. A smooth curb reflects light away from the driver—and therefore is not so readily seen.

When rain at night makes road and curb a watery mirror, this difference is even more marked. A smooth curb is almost invisible. A Reflecting Curb shines as a white guide to safety—far ahead.

When planning post-war improvements or new highways, write to our Atlas White Bureau for further information. Ask for a copy of the book "A White Guide to Safety."

A smooth curb (above) wastes light . . . reflects it up and away from the driver. A White Concrete Reflecting Curb (below) conserves light . . . reflects it back to the driver. A smooth curb is barely visible at night; a White Reflecting Curb stands out—bright and clear.



ENR-DC-1

UNIVERSAL ATLAS CEMENTS

UNIVERSAL PORTLAND • ATLAS PORTLAND • ATLAS WHITE • ATLAS DURAPLASTIC • ATLAS HIGH-EARLY

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • JANUARY 27, 1944 • VOLUME 132 • NUMBER 4

Collective bargaining plan dominates A.S.C.E. meeting

Proposal to amend constitution of the society's local sections to permit them to create collective bargaining groups opposed heatedly and strongly endorsed

A normally good program of technical pers at the annual meeting of the erican Society of Civil Engineers, d in New York City, Jan. 17-21, was ost completely eclipsed this year by cussion of the society's program for ting up collective bargaining units engineers, which was adopted by the rd of direction at its October meet- in Atlanta.

n response to several requests that board's action in providing for col- tive bargaining within the society's mework be discussed at the annual iness meeting, Wednesday afternoon s set aside in the program for discus- n of that subject. Because of that eduled discussion, a motion intro- ed at the morning meeting to request board to reconsider its action at At- ta and to do nothing further on the tter until the matter can be put to e of the members was tabled until afternoon session.

Before the afternoon meeting was wn open for discussion, A. M. wn, chairman of the society's com- tee on employment conditions, which prepared the report that was ap- ved by the board at Atlanta, reviewed developments within the society that led up to the committee's proposal. Rawn also reported that 15 of the ections already had voted to amend r constitutions in line with the com- tee's recommendations. In every in- ce the proposal carried by a large ority, the average being over 90 per- t of the voting members. In only one ion where the proposal had been put ote was it lost, and that was due to ure of at least 50 percent of the ible members to cast a vote, as re- ed by the section's constitution. The ions that have taken this action are Central Ohio, District of Columbia, Angeles, Georgia, Kansas City, yland, Miami, Oklahoma, Oregon, Pittsburgh, Porto Rico, San Diego, Seattle, Tennessee Valley and West Virginia.

Some strong opposition

Discussion from the floor indicated some strong opposition to the proposal, chiefly in the Metropolitan Section (New York) and the Northeastern Section (Boston). In neither of these sections has the matter been put to vote, and only in Boston has it been discussed in open meeting.

Failure of the Metropolitan Section to discuss the proposal in open meeting or to put it to vote was the subject of caustic comment by Joseph D. Lewin, representing a group of young engineers in New York City who do not want to join any of the existing unions but who are under pressure to do so.

Those who opposed the establishment of collective bargaining groups by the sections, generally did so on the ground that such collective bargaining units are unnecessary, that they will be weak and ineffective, and will cause a split within the society between employees and employers. Some also held that once the collective bargaining agencies are set up by the sections, the unions will take them over, with the result that they will only facilitate the spread of the union movement among engineers.

When the motion came to vote it was lost by a vote of 97 for the motion and 120 against it.

Medals presented

The annual meeting opened with the presentation of society medals and prizes and the awarding of honorary memberships to the men pictured on p. 87.

The Norman Medal, highest of the society honors, went to Thomas E. Stanton; the J. James R. Croes Medal was awarded to Carl H. Gronquist; the Thomas Fitch Rowland Prize to Paul Baumann; the James Laurie Prize to Thomas A. Middlebrooks, and the Arthur M. Wellington Prize to Milton Harris. Ray K. Linsley and William C. Ackermann received the Collingwood Prize for Juniors; Harold A. Thomas and Emil P. Schuleen received the Karl Emil Hilgard Prize; Carlton B. Jansen was awarded the Construction Engineering Prize; and the Rudolph Hering Medal went to George J. Schroepfer.

New officers

At the close of the business session the tellers reported the election of Malcolm Pirnie, consulting engineer, New York, as president to succeed Ezra B. Whitman of Baltimore. New vice presidents are Richard E. Dougherty, vice president, New York Central System, New York, and Franklin Thomas, professor of civil engineering, California Institute of Technology, Pasadena. New directors are S. C. Hollister, dean of the College of Engineering, Cornell University, Ithaca, N. Y.; Gail A. Hathaway, hydraulic engineer, Office of the Chief of Engineers, U. S. Army, Washington; Raleigh W. Gamble, superintendent, Bureau of Street Repair and Construction, Milwaukee; Wilbur M. Wilson, research professor, civil engineering department, University of Illinois; Frank C. Tolles, consulting engineer, Cleveland; William D. Shannon, consulting engineer, Seattle, Wash.; and R. J. Tipton, Denver consultant.

Symposium on cavitation

The morning session of the Hydraulics Division was devoted to a symposium on cavitation in hydraulic structures. John K. Vennard, New York University, outlined the fundamentals of cavitation, pointing out that the mechanism of cavitation is composed of four parts, namely: (1) the formation of the cavity or small air pockets in the low-pressure regions of the liquid; (2) travel of the cavity; (3) collapse of the cavity; and (4) the consequences of the collapse, which often results in pitting of the walls of the structure through which the liquid flows.

For elimination of cavitation in new structures, Professor Vennard recom-

(*Continued on page* 86)

Surplus machinery disposal worries Associated Equipment Distributors

Delegates at Chicago meeting endorse the proposed 6-point distribution program to be controlled by the Reconstruction Finance Corp., and operated thru established trade channels.

Despite assurances from representatives of the armed forces that much of the used construction equipment now available in the country would be expended as war materiél and that plans now being formed would dispose of all equipment, both old and new, owned by the Army and Navy after the war in a fair manner, much concern was expressed over disposition of surplus machinery by more than 1,000 dealers and manufacturers attending the 25th annual meeting of the Associated Equipment Distributors at Chicago Jan. 16-20.

The delegates heartily endorsed the six-point program of distribution provided in a bill now before Congress by which the disposal and sale of such equipment would be controlled by the Reconstruction Finance Corp. Chief features of the distribution plan include disposal of the equipment through established trade channels and at a rate which would not disrupt trade or commerce, prevention of the acquisition of large stocks for speculative purposes, uniform selling prices at such levels as to insure the government a fair return, and the protection of small business firms in the field.

Disposition of surplus equipment was the principal topic at two round-table sessions. Government interests were represented by Lt. Col. E. R. Needles, Corps of Engineers; Capt. L. N. Moeller, (CEC) U. S. Navy; Henry Hale, WPB; and Clifton Mack, procurement division of the Treasury department. Four distributors and four manufacturers represented private industry in the discussions.

Army and Navy views

Col. Needles declared that the army hopes to use up or send overseas all army-owned machines. The army is reconditioning all of its equipment; new and used units in best shape go overseas for combat duty, while older models and badly worn machines are reserved for troop training and for maintenance at posts and bases. He said if the present demand for equipment continues for another six months there will be no problem of surplus.

Capt. Moeller reported that the Navy now owns construction equipment valued at $64,000,000, and that very little of it would be returned to this country. Seabee equipment, he pointed out, is so expendable that the average life is less than one year. The navy has three big depots in this country for reconditioning its equipment. Present regulations permit the navy to sell surplus equipment, if it desires, to private buyers, and some machinery has been disposed of in this manner "without competition to private industry."

Construction equipment production jumped from $120,000,000 a year in 1935 to $721,000,000 in 1943, according to Henry Hale. The present backlog of orders approaches the 1943 output, he said.

An industry committee recommendation for disposition of surplus equipment, outlined by Mort Hunter, Milwaukee distributor, provided that: (1) All equipment be screened for various governmental agencies; (2) the remainder be offered to private firms doing war work; and (3) any surplus from the foregoing be sold to the highest competitive bidder from the field in which the equipment originated.

G. W. Van Keppel, new president of the Equipment Distributors

The A.E.D. adopted a resolution to combine its efforts with other organizations in the equipment industry and with other industries faced by the same problems of disposal of surplus government equipment so that a united front might be presented to the agencies, charged with the equipment disposal.

Equipment distributors were told by Maj. Gen. Philip B. Fleming, administrator of the Federal Works Agency that they have a special obligation to see that all construction equipment now in their possession as well as any that comes into their possession between now and demobilization day be kept in first-class working order.

Maj. Gen. Eugene Reybold, Chief of Engineers, U. S. Army, voiced a stern warning to the assembled equipment distributors and manufacturers to supply replacement and repair parts for construction equipment overseas according to schedules established by the armed services, and not according to any replacement schedules based on peacetime operation of equipment.

Postwar highway construction must be based on need rather than upon geographical consideration, according to a preliminary report by G. Donald Kennedy, vice-president of the Automotive Safety Foundation. This recently completed six-month survey of needed highway construction shows that 86 percent of all traffic moves over only 25 percent of the country's highways.

That the passenger car is a utility vehicle rather than a pleasure automobile was brought out in the survey. It disclosed that 77 percent of all trips are for business purposes, and 90 percent of then are of less than 30 miles.

Equipment monopoly charge

No disturbing effects are expected to occur in the existing relationships between equipment distributors and manufacturers, nor in their normal methods of doing business, as a result of charges by the Federal Trade Commission that the Association and its members have conspired to suppress competition and to maintain a monopoly in the sale and distribution of rock crusher equipment. This was the opinion of Rufus G. Poole, Washington attorney, who represented the Association during the investigation. The acts complained of by the Commission as suppressing competition, said Mr. Poole, occurred in 1939 and 1940, and have not occurred since.

An order issued Jan. 8 by the Commission prohibits arrangements for uniform commissions and practices which might restrain competition on Government business, said Mr. Poole. He expressed the opinion that this order could not be made applicable to many situations for which it was intended.

New officers

G. W. Van Keppel of Kansas City, Mo. is the newly elected president succeeding Edward P. Phillips of Richmond, Va. Other new officers for the forthcoming year include: H. O. Penn, New York, executive vice president; Frank B. McBath, Portland, Ore. and William A. Danner of Boston, Mass., vice presidents. C. F. Winchester, Washington, D. C., executive secretary and W. W. Bucher, New York, were reelected.

North tube work resumed on Lincoln Tunnel

Work on the north tube of the Lincoln Tunnel under the Hudson River between New York City and New Jersey, delayed a year as a result of shortages of essential materials, has been resumed and will be completed in July. This was announced Jan. 17 by Austin J. Tobin, executive director of the Port of New York Authority. Tobin said indications are the Lincoln Tunnel will become the chief artery for New Jersey-New York traffic in five years.

Traffic now flows in both directions through the south tube. When the north tube is opened traffic will flow in one direction only in each tube.

The only work remaining to be done is installation of electrical equipment, held up by the copper shortage. Tobin said the War Production Board has given the go-ahead signal on the 55 tons of copper needed for lighting, ventilation and signaling equipment. Installation of electrical equipment is being made by the Broadway Maintenance Corp. of Long Island City at a cost of $365,000.

Tobin said that 18,613 vehicles passed through the tunnel Christmas eve, that 883,000 vehicles used it last month, and 3,553,000 used it in 1943. The one tube now in operation is being used almost to capacity, he said.

. . .

Public utility committee for freed territories

A special public utilities committee which will assemble information and recommend action concerning requirements, supplies and production of equipment necessary to re-establish electric, gas and water services in liberated and former enemy territories has been formed by the Combined Production and Resources Board, it was announced in Washington, recently.

Chairman of the committee and American member will be J. A. Krug, director of the Office of War Utilities in the War Production Board. The member for Great Britain will be Sir Henry Self, Deputy United Kingdom member of CPRB; the member for Canada will be T. H. Hogg, chairman of the Hydro Electric Power Commission of Ontario.

The committee is expected to survey requirements and the availability of utility equipment and to decide, in conjunction with other operating organizations of the three governments, on any necessary production programs for equipment to meet utility needs in liberated and former enemy areas.

JOBS OF THE WEEK

SERVICES FOR HOUSING DEVELOPMENT, Houston, Tex.

Collins Development Co., Houston, awarded a contract for roads, excavation, drainage, streets, utilities, clearing, grubbing, and sewage disposal, for 400-unit housing development, to Russ Mitchell, Inc., Houston, at $1,800,000. David M. Duller, Houston, is the architect.

AIRPORT, Matagorda, Tex.

Brown & Root, Inc., Houston, have been awarded an additional work contract for firing-in-range, runways, taxiways, apron expansion, at airport to cost $1,011,404. U. S. Engineers, Galveston, Tex., awarded the contract.

DWELLINGS, Whittier, Calif.

Whittier Construction Co., Los Angeles, Calif., will construct with its own forces 125 frame dwellings, to cost $550,000.

RUNWAYS EXTENSION, Miami, Fla.

Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded a contract for runway extensions, at Naval Air Station to R. H. Wright & Sons, Columbus, Ga., at $906,583.

MARINE BARRACKS, Klamath Falls, Ore.

Brennen & Cahoon, Pendleton, Ore., have been awarded a contract by the Bureau of Yards & Docks, Navy Department, Washington, D. C., for marine barracks, messhall and cook's quarters at the Marine Barracks, to cost $1,507,261.

HOSPITAL, Farragut, Idaho

Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded a contract for 500-bed extension to Naval Hospital, to Sound-Kiewit Construction Co., Farragut, Idaho. The project will cost $1,209,962.

OIL DEVELOPMENT and OTHER BUILDINGS, Mexico

Petroleos Mexicanos (Pemex), Mexico City, will build by its own forces a 100-octane gasoline refinery. Project will also have a pipe line, well development, housing, schools and hospitals for workers. The estimated cost is $12,280,709. Arthur G. McKee & Co., Cleveland, O., are the engineers for the refinery.

AIRPORT WORK, New York

Commissioner Marine & Aviation, New York, N. Y., awarded a contract for placing 3,000 cu.yd. hydraulic fill, at Idlewild Airport, Queens County, to Gahagan Construction Corp., Brooklyn, N. Y., at $694,500; also 3,500,000 cu.yd. to Atlantic, Gulf & Pacific Co., New York, N. Y., at $556,500. Jay Downer, New York, N. Y., is the engineer.

HOUSING DEVELOPMENT, Cuyahoga Falls, O.

Woodland Homes, Inc., Akron, O., will construct by separate contracts 200 dwellings, to cost $1,000,000.

ALUMINA-CLAY PLANT, Salem, Ore.

Chemical Construction Corp., New York, N. Y., has been awarded a contract for the design and construction of an alumina-clay plant by the Defense Plant Corporation, Washington, D. C. The estimated cost is $4,500,000. Columbia Metals Corp., Seattle, Wash., will operate the plant.

HOSPITAL, Astoria, Ore.

Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded a contract for miscellaneous buildings, for Naval Hospital to L. H. Hoffman, Portland, Ore., at $1,193,000.

BRIDGES, Venezuela

Ministerio de Obras Publicas Direccion de Vias de Communicacion, Caracas, received lowest bid for seven reinforced concrete highway bridges along Carretera Occidental, between Ospino and Barinas, States of Portugesa and Barinas, from Gonzalez & Bolivar, Caracas, with a bid of $1,886,666. Rodriguez & Rivero, Caracas, was second low at $2,126,666. Raymond Concrete Pile Co., Los Angeles, Calif., and Pomeroy Construction Co. of California, San Francisco, Calif., bid $2,250,000.

Note—Additional bidding and contract news on many projects large and small appear in the Construction News section beginning on page 203.

A.S.C.E. meeting report

(*Continued from page* 83)

mended "streamlined" designs to avoid sharp curvatures, abrupt corners and other forms that produce flow curvature, vortices, eddies, and high local velocities. He also emphasized the importance of model studies before starting construction. Replacement of the eroded parts with a tougher material and the admission of air to the low-pressure regions were recommendations to reduce the destruction by cavitation of existing structures.

In describing cavitation experiences of the Corps of Engineers, John C. Harrold, hydraulic engineer with the corps, also emphasized the importance of model studies to prevent cavitation. Two types of models offer advantages: (1) models in a vacuum tank of the type developed at Carnegie Institute of Technology, and (2) models making use of an electric pressure device developed at the U. S. Waterways Experiment Station, Vicksburg, Miss., to measure rapid pressure fluctuations.

Each method offers advantages

The vacuum method permits the cavitation action to be observed, but by this method it is difficult to determine to a refined degree the point at which cavitation disappears. With the pressure measuring procedure the point at which cavitation ends may be noted, but there is often question as to whether the piezometer openings are placed in the correct location to indicate the lowest pressures. However, with proper case, both methods give fairly accurate results, according to Mr. Herrold, who believes cavitation testing opens a broad field for research.

Cavitation experiences of the Tennessee Valley Authority were described by George H. Hickox, senior TVA hydraulic engineer. To date the TVA has experienced cavitation in only one of its structures, a sluiceway of Norris Dam, according to Mr. Hickox.

Cavitation experience of the Bureau of Reclamation was described by Jacob E. Warnock, senior engineer in the bureau's Denver laboratory. He cited the 72-in. Boulder Dam needle valves and the Shoshone Dam balanced valve outlets as examples of pitting in conduit flow. Two examples of pitting in open channels described were the Arizona spillway tunnel at Boulder Dam and the spillway pier faces at Parker Dam. In each case remedial measures were made possible by model studies.

The sessions of the Hydraulics and Power Divisions were devoted to hydraulic design advances in work of the Tennessee Valley Authority. After Theodore B. Parker, former chief TVA engineer and now head of the department of civil engineering at Massachusetts Institute of Technology, had reviewed the major hydraulic objectives of the TVA work, George R. Rich, chief TVA design engineer, gave numerous details of the hydraulic design work. TVA experience with model studies to assure good lockage conditions in the Kentucky Dam lock, which has a 70-ft. lift, revealed much valuable data on lock design.

Mr. Rich, in discussing the setting of turbines, emphasized that a decision on whether to use a deep setting or a shallow setting for the turbines is a problem that must be evaluated for each project. A deep setting permits a smaller runner with the resultant lower cost for generating equipment, but cost of construction will generally be higher than for a shallow setting, which may permit lower construction cost but more expensive generating equipment.

Hydraulic operation of the entire TVA system, which is aimed at the maximum benefit for navigation, flood-control, power production, and malaria-control, was the basis of a paper by Clarence E. Blee, TVA chief engineer. Mr. Blee reported that the total installed hydro-electric generating capacity of the 27 plants now completed or under construction on the Tennessee River and its tributaries amounts to 2,068,000 kw; that the combined gross storage reservoir capacity totals 21,000,000 acre-ft. with 14,000,000 acre-ft. usable within normal operating levels; and that the continuous length of navigation channel will be 650 miles, extending from Paducah, Ky., to Knoxville, Tenn. The navigation benefits are pronounced, Mr. Blee reported, pointing out that freight traffic on the Tennessee River increased from 33 million ton-miles ten years ago to over 200 million ton-miles in 1943. In a like manner, the TVA system of dams is expected to provide sufficient flood storage to lower maximum floods on the lower Mississippi by 2 ft. at Cairo, Ill.

Other TVA papers covered hydro power station design by George P. Palo, principal civil engineer; Watts Bar steam station design by Adolph A. Meyer, head civil design engineer; and structural features of TVA hydraulic structures other than power houses by Ross Riegel, head civil engineer. Because of their character, being concerned with the numerous details of design, the papers do not lend themselves to abstracting.

Many maps found defective

In speaking before the Surveying and Mapping Division Frederick L. Olmsted, consultant of Brookline, Mass., reported that in his work during the past few years he had inspected thousands of maps and had found a large proportion defective. One of the most common shortcomings on general topographic maps is the lack of points located on the map which can be easily identified in the field.

In describing the extensive mapping work required as part of the army cantonment program, Arlow V. Ferry of Black & Veatch stated that maps of the desired accuracy could be prepared faster by plane-table than by transit, but that most surveymen knew little about the plane-table method.

W. N. Brown of W. N. Brown, Inc., Washington, emphasized the need in map making for planning the survey before any work starts, the value of monumental control, and the benefits obtained by the use on every map of a grid system and control points.

Two educational features considered necessary by Philip Kissam, Princeton University, if surveying students are to be better trained are (1) greater utilization of the knowledge of practicing engineers engaged on survey work and (2) the solution of more comprehensive problems of larger size.

Some structural topics

Descrying the fact that engineers do their designing, even of monumental structures, with only a stress diagram and a slide rule, Aymar Embury, II, a practicing architect, told the Structural Division that engineers and architects each need the services of the other. He emphasized that architects often design excessively heavy through ignorance while engineers thought only of stress and economy.

Elsie Eaves, head of the statistical and business news departments of *Engineering News-Record*, outlined for the Structural Division the place of the construction industry in the national economy.

Americans spent 17 percent of their entire national income in 1927 for construction and attendant maintenance—only 10 percent in 1933. In 1942, 14.5 percent of the national income went into construction and in 1943 the amount was the same as in 1938.

Miss Eaves showed anticipated construction budgets of 12 to 26 billion dollars for the first year after the war.

Speaking with "Search and Research" as a topic, John I. Parcel of Sverdrup & Parcel, consulting engineers of St. Louis, urged the accommodation of more facts on the questions of structural damping and the effect of impact and vibration on the ultimate strength of structures. Knowledge of wind loads is far from adequate. In truss bridges the shielding effect and drag of various members is incompletely determined.

Discussing Mr. Parcel's paper, Wilbur M. Wilson, research professor in structural engineering at the University of Illinois, made the comment that failure of engineering structures had seldom, if ever, been due to faults in design but rather to factors whose presence or potential appearance was not anticipated. Speaking of designing structural members for fatigue, Professor Wilson pointed out that it is difficult to determine what the fatigue strength of a structural member may be. His research group has spent six to eight years and $60,000 upon reversal of stress investigations without getting definite answers.

Activities of the Seabees

Capt. Kirby Smith, director of the construction department of the Bureau of Yards and Docks of the Navy, told the Construction Division of the activities and accomplishments of the Navy's Construction Battalions, the Seabees.

As originally organized two years ago, the construction battalions were to consist of 3,300 men but the corps now has been increased to an expected total of 290,000 men, half of whom are now overseas. An unusually graphic picture of Seabees under combat, not released heretofore, was shown to illustrate the activities of the Seabee units.

Sanitary engineering sessions

Organization, training and staffing of engineers for promotion of the war effort was a dominant theme in the meetings of the sanitary engineering division. Gordon M. Fair, of Harvard University, and chairman of a committee that has for several years been devoting its efforts to the "advancement of sanitary engineering," stated that the impact of war furnished new opportunities for sanitarians to participate in the important tasks of military and civilian health protection. Demands for sanitary engineers in the armed forces have far outstripped the available supply of men and this has resulted in the introduction of special training courses at five universities.

Operation of the Procurement and Assignment Service to provide for the orderly withdrawal of sanitary engineers from civilian activities to military duties was outlined by Captain David Smallhorst, executive officer of the service.

At present, said Captain Smallhorst, 1,223 are in military service, 515 have been declared essential in civilian health protection, and 288 more have been determined to be available for service. Withdrawal of men for the army Sanitary Corps is now virtually completed, commissioning of candidates from civil life having ended on Jan. 1, 1944. The

(*Continued on next page*)

A.S.C.E. honors four members

Honorary membership in the American Society of Civil Engineers was conferred on four members at the annual meeting held in New York Jan. 19. They are Gerard H. Matthes, Frank T. Crowe, Thomas H. MacDonald and Edward H. Connor.

Gerard H. Matthes is a native of Holland, having been born in Amsterdam in 1874. Coming to this country in 1891, he entered Massachusetts Institute of Technology, graduating in 1894. His experience has centered chiefly around hydraulics as applied to river control. He also was one of the early advocates of aerial surveying, having used it in mapping the Tennessee Valley. In 1932 Mr. Matthes was appointed principle engineer of the Mississippi River Commission, Vicksburg, in which work he made notable contributions to flood control in the Mississippi. He now is head of the U. S. Waterways Experiment Station at Vicksburg.

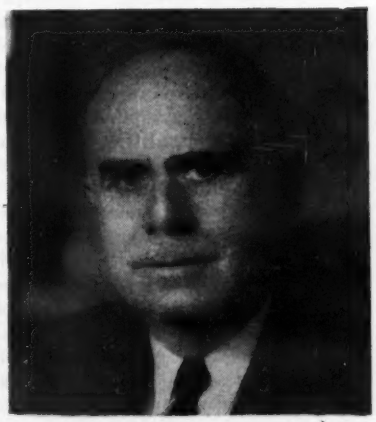
Frank T. Crowe is a Canadian by birth and a graduate of the University of Maine in 1905. Most of his career has been spent in dam building, first as an engineer with the U. S. Bureau of Reclamation and then with contracting organizations. He was general superintendent on Boulder Dam for Six Companies. Subsequently he was at Parker Dam and now is general superintendent on Shasta Dam.

Thomas H. MacDonald came from Leadville, Colo., and graduated from Iowa State College in 1904. After two years of teaching he went into highway development, which he has made his life work. Following 15 years with the highway commission of Iowa he was called to be chief of the U. S. Bureau of Public Roads in 1919. When that bureau became the Public Roads Administration he was continued as its head.

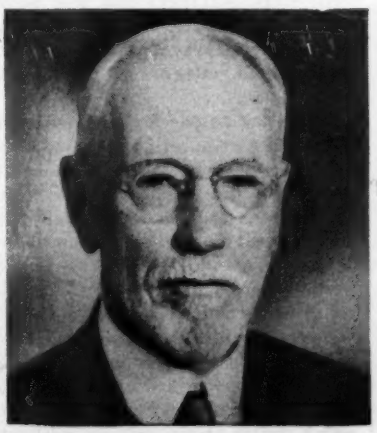
Edward H. Connor has devoted his career to bridge building. Born in Alton, Ill., in 1864, he graduated from the University of St. Louis in 1887 during the great era of railroad expansion. In 1899 he was employed as an engineer for the Missouri Valley Bridge and Iron Works, Leavenworth, Kan., becoming vice president and chief engineer in 1904. In this work he had a part in many great bridge building projects, including the Bay Bridge at San Francisco, where he served as managing engineer. He now is consulting engineer of the Missouri Valley Bridge and Iron Works.

Gerard H. Matthes

Frank T. Crowe



Thomas H. MacDonald



Edward H. Connor

Navy, he said, would need a few sanitary engineers, and the U. S. Public Health Service required about 100 more men.

Lt. Col. Joseph Gilbert, personnel officer of the Sanitary Corps, stated that two years ago when the Corps included 60 engineers, steps were taken to augment this category by 70 more men. Since that initial drive, the engineer complement of the Corps has been successively increased until at present it includes nearly 800. Of this number, 365 are engaged on malaria control work.

Mark D. Hollis, sanitary engineer, U.S.P.H.S., revealed that his organization has instituted malaria control work in some 900 areas in 1942, and during 1943 this was increased to 1,200 places. Through larvicidal applications and drainage it has been possible in 92 percent of these areas to restrict the density of anopheline mosquitoes below numbers required for transmission of malaria. On a probability basis, it was his estimate that the chances of an individual receiving malaria from a single mosquito were 1:33,000.

Malaria control in the Tennessee Valley, where reservoirs and lakes have a total shoreline of 9,000 miles, was described by W. G. Stromquist, principal sanitary engineer of the TVA. The control program involves pre-clearing of inundated shoreline areas, varying of lake levels to strand drifts and kill shoreline vegetation, application of larvicides, and the installation of permanent improvements such as dikes to prevent flooding of low areas.

The possibility is remote that the return of troops from malaria and other disease-ridden war areas will be followed by the risk of epidemics in the United States, reported Lt. Col. Gaylord W. Anderson, of the army Medical Corps. He based his conclusions on theoretical considerations and past experience records. Among other things, these reveal that relatively few troops will be infected by malaria on their return; small outbreaks that may occur will be local and temporary in nature because environmental and other factors in the United States are not favorable to transmission.

Other discussions in the sessions of the sanitary engineering division, all of which were conducted under the chairmanship of A. Clinton Decker, sanitary engineer of the Tennessee Coal, Iron and Railroad Co., included a description of New York City's postwar sewage works program by Richard Gould, director of the engineering division of the department of public works; an analytical report on progress in sewage disposal by Langdon Pearse, sanitary engineer of the Chicago Sanitary District; and a review of progress on the South District water filtration plant by W. W. DeBerard, city engineer, and Fred Gordon, senior filtration engineer, Chicago department of public works.

New officers of the sanitary engineering division are Ray Goudey, Los Angeles, chairman, and George Schroepfer, Minneapolis, secretary.

Inclined shaft sinking

Starting with the statement that New York now ranks above many so-called mining states in value of minerals produced and in a few years may be the greatest mining state in the Union, Fred Stiefel, of Stiefel Construction Corp., told the construction group about sinking an inclined shaft for an iron ore mine some 8 miles west of Lake Champlain near the town of Mineville. The project is planned to take out 3,000,000 long-tons of crude iron ore per year for the Republic Steel Corp.

The shaft is being constructed now to a depth of 2,000 ft. on a slope of 33½ deg. to the horizontal. The shaft plant is planned to ultimately sink and operate the mine to a depth of 5,000 ft.

Relief wells for dams

Speaking before the Soil Mechanics and Foundations Division, T. A. Middlebrooks, senior engineer of the Office of the Chief of Engineers and William H. Jervis of the U. S. Waterways Experiment Station at Vicksburg, Miss., described in detail means for relieving pressure on the downstream side of earth structures. Noting that since 1930 many large flood-control dams and levees had been successfully constructed over relatively impervious fine alluvial material resting on pervious sand and gravel, the authors told of the deep drainage or relief wells that had been found necessary to prevent dangerous boils and seepage.

The wells as now used are put down by some kind of well drilling unit, generally with a 6-in. dia. casing inside which a porous pipe, now most frequently of concrete, is inserted and the casing withdrawn, leaving a vertical column into which water may percolate and rise to the surface much as an artesian well. Such a pipe will permit the flow of about 1 cu.ft. per sec. under moderate head. However, a penetration of about 25 percent of the permeable strata seems to be necessary.

Brief comments by Glennon Gilboy, consulting engineer of Lincoln, Mass., and Willard J. Turnbull of the Waterways Experiment Station at Vicksburg emphasized particularly that relief wells should be made part of the original design in soil where relief may be necessary. Design may thus be coordinated and some advantage taken of the relief wells to reduce the other drainage required.

Stability of cofferdams

Karl Terzaghi, consulting engineer, Winchester, Mass., lead off the discussion of the stability of cellular cofferdams in the Soil Mechanics and Foundations Division meeting with a review and analysis of cellular cofferdam design from the time the type was first used in connection with the salvaging of the battleship "Maine" to the permanent installations recently made to form basins in which to build ships.

Dr. Terzaghi brought out that it is not correct to treat a cellular cofferdam as a gravity structure. The composite construction of steel walls and fill must be analyzed separately, principal stability of the structure being obtained from the fill but high frictional resistance to sliding of the interlocks is desirable. He emphasized that vertical shear in the cell fill, heretofore generally ignored, is most important and that cells do not drain to the bottom as has been previously assumed thus higher interlock stresses are probable.

In discussion, C. B. Jansen, manager of the general construction department, Dravo Corp., raised question concerning the high carbon content of steel sheetpiles, showing a slide of a cofferdam where ice flowing over the top had ripped some of the sheets. He recommended a reduction in carbon content to give the piles greater ductility. A later speaker explained that the manufacturers used the present high carbon content to meet the demands of hard driving.

A. J. Ackerman, director of engineering, Dravo Corp., noted with favor the greater use of cellular sheetpile cofferdams for permanent structures, pointing to the submerged shipways constructed by his company (*ENR*, Oct. 21, 1943, p. 588) at one-third of the cost of similar ways built by other available means. Such structures, he said, may have a life of 50 years.

R. T. Colburn, construction plant engineer of the Tennessee Valley Authority, advocates use of the circular type of cofferdam rather than the crosswall type, stating that for heights over 40 to 50 ft., there is no added cost and that the circular cells have many advantages for hydraulic filling as the cell is self-supporting.

G. G. Greulich, consulting engineer, Carnegie-Illinois Steel Corp., likened the cellular cofferdam to a barrel without a head, pointing out that if fill in the cell is not compacted, so as to place tension in the interlock, the cell may act as a barrel with loose hoops.

Martin M. Lautz, Bethlehem Steel Corp., commented on vertical shear of the cofferdam structure and discussed sliding resistance in interlocks of crosswalls. He showed pictures of some unusual cellular cofferdams.

The Highway Division and the City Planning Division started their meeting by a joint session at which Thomas H. MacDonald, commissioner, and H. S. Fairbank, deputy commissioner of the Public Roads Administration and George E. Spargo of the Triboro Bridge Authority, New York, spoke on subjects of interest to the two divisions.

Mr. Fairbanks, in discussing postwar highway planning, reported that only 16 millions of the 50 million dollar federal fund available for postwar highway planning had been requested by the state highway departments.

Mr. MacDonald took as his subject the effect of the projected interregional highway system (see p. 142 of this issue) on the cities through which the system will run. He expressed the view that cutting superhighways through blighted areas of cities should help to restore those areas to usefulness, particularly if the cities will do their part through proper zoning in checking unjustifiable extensions of business and commercial zones along those highways.

The cities, Mr. MacDonald said, must inaugurate their parts of the projected system and must pass the necessary local laws to limit access to the highway and to provide the necessary land for access streets and parking facilities.

Mr. Spargo endorsed most of Mr. MacDonald's statements but raised question as to whether the interregional highways would do much to solve the blighted-area problem of most cities.

Airplane runway data

Because of the close similarity between highway and airport construction, a committee on design and construction of runways and flight strips has been set up by the Highway Division. Frederick N. Schnepfe, head of the FWA flight strip division, as chairman of the committee reported on some of the design questions now under consideration, and announced a program of assembling data that the Army and Navy air forces have collected during their extensive airbase operations. These cover runway and taxi patterns, positions of buildings, effects of different types of landing gear on runway maintenance, and experiences in landing aircraft at various angles to the wind. In the latter connection, Mr. Schnepfe pointed out that with tricycle landing gear planes can use a field with single-direction runways nearly 90 percent of the time. This fact was further emphasized, in discussion, by Jay Downer, designer of New York City's Idlewild Airport, who said that seven of its nine runways will be laid out in one direction. As a further indication of the scope of design thinking, Mr. Downer said that 200,000-lb. planes composed the "design loads" for the runways.

A great "style center" proposed for New York

Construction of a world fashion center, comprising six to ten new buildings to house the leading apparel and allied interests of the country, as "New York City's postwar business project No. 1," was proposed in a report made public Jan. 23 by Mayor LaGuardia's Committee for World Fashion Center.

The committee, consisting of fifty-three business, industrial, labor and civic leaders, declared that such a center "would be desirable and of great benefit to the city" and that it "should be constructed only on the basis that its cost would be entirely self-liquidating within the period of years of its probable economic utility."

Coupled with the fashion center group of buildings, the committee suggested that the city erect as a war memorial a group of three buildings, including a convention auditorium seating 25,000 and opera house seating 5,000, a music hall, and a school of industrial art, as well as underground parking areas.

Taken separately, the fashion center group of buildings would cost from an estimated $42,969,600 to $91,155,800, according to the site, and the city's buildings would cost from $35,681,965 to $54,104,250. On most of the proposed sites the cost of the fashion center would be greater than the city buildings. Taken as a whole the project would be comparable to Rockefeller Center both in cost and scope.

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New WPB rules regarding construction equipment

Certain items of construction equipment formerly produced only for military use are now available for civilian use through specific WPB authorization instead of only on appeal, the War Production Board has announced. Procedure for obtaining construction equipment repair parts has also been simplified. These changes are made through issuance of order L-192 as amended on Jan. 10. Chief new provisions of the amended order follow:

Schedule C, which listed items that could be produced only for military use, is deleted. Items formerly in Schedule C are transferred to Schedule A, making it possible for a civilian purchaser to apply for a WPB authorization instead of filing an appeal.

Certification procedure in the purchase of repair parts is simplified by requiring the purchaser to execute a certification stating that the purchase order is "authorized under Order L-182." This certification may be added to any certification used in applying an MRO preference rating. Formerly the certification required under L-192 called for detailed information on the equipment for which repair parts were needed.

With certain exceptions, repair parts are obtainable only to the amount necessary for a 30-day inventory. Formerly such parts could be purchased only for actual or impending breakdown.

Appeals from the provisions of the order are now filed with the nearest WPB field office instead of in Washington.

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Byrd report misleading on construction saving

A recent report of the Joint Committee on Reduction of Nonessential Federal Expenditures, of which Senator Harry F. Byrd, Virginia, is chairman, indicates that, upon recommendation of the committee, Congress has effected a $2 billion saving, of which nearly one-fourth is in federal construction.

While at first glance it would seem that this would curtail construction by about half a billion dollars, a study of the situation by *Engineering News-Record* indicates that the committee's report should not be so construed.

Because construction has been restricted by Presidential action to projects certified as essential to national defense and some civilian necessity, funds for new work have been allotted only to projects which are certified either by the War Department, the Navy, or the War Production Board, so that the need for appropriations for other work has ceased to exist.

The fact that Congress last July extended the availability of approximately $168 million unexpended federal-aid funds until one year after the war—funds which would otherwise have expired in June of this year or next—indicates that it has not been the intention of Congress to restrict highway construction for reasons other than to save labor and material for the war effort, and that the curtailment of the highway program has resulted more from war conditions than from the committee's recommendations.

That conclusion goes also for other construction savings listed by the committee. The report lists a saving of $50,300,000 by deferment of expenditures for federal highway projects for 1943; $56,985,000 savings on 1943 Interior Department public works, and $52,719,470 for 1944.

Other 1944 savings listed are public building construction $33,148,000; rivers and harbors, $181,894,100; rural electrification $90,000,000.

Sludge digestion aids outlined at New York State Sewage Works meeting

Small amounts of ammonia salt found helpful in starting and maintaining digestion tank activity. Larkin is elected president of association.

Reporting successful efforts in stimulating digestion of sludge and controlling formation of scum in tanks of a large Navy sewage treatment plant, Harry E. Schlenz, vice president of the Pacific Flush-Tank Co. told the New York State Sewage Works Association meeting on January 21 that these results were achieved largely by the addition of small amounts of ammonia nitrogen. The latter was added in the form of ammonium sulphate, the amount equivalent to about 35 ppm. of available ammonia nitrogen on the basis of the total primary tank volume.

Stating that research had not yet proceeded to the point where he could answer the question why it was desirable to add ammonia nitrogen to a digesting sludge mixture already containing a large amount of nitrogen, Mr. Schlenz said that the fact was that it has proven beneficial. He cited previously successful results in controlling scum fermentation in digestion tanks at Olean, N. Y., where periodic additions of 40 ppm. of an ammonia salt were made.

At the Navy installation, the sludge tanks showed no sign of digestion after nine months operation, despite large additions of lime and the application of heat. The tanks contained a 9-ft. layer of heavy scum, which was so viscous that it could not be pierced. Over a 15-day period some 500 lb. of ammonia sulphate was added to the tank, and thin sludge at the bottom of the tank was recirculated over the scum later. Gas production soon followed, and in three months the tank was functioning in good order.

More recent trials at Buffalo, using ammonia salts for reduction of scum solids, also has produced optimistic results, stated Mr. Schlenz.

Discussion of the paper revealed considerable doubt from a theoretical viewpoint that ammonia-nitrogen additions alone could be fully credited with the success achieved.

Canadian sewerage prospects

One of the major postwar developments in Canada will be the installation of sewerage facilities, according to A. E. Berry, director of sanitary engineering in the Ontario department of Health. He stated that in contrast to the 1,300 waterworks systems now in use, only 500 municipalities had sewerage improvements, of which only 115 have treatment works in operation. Not only is there a defined need for additional facilities, said Dr. Berry, but Canadian municipalities are in the fortunate financial position to undertake new capital expenditures.

South American activities

Health and sanitation activities in South America, stimulated and supported with funds made available by the Office of the Coordinator of Inter-American Affairs, are one of the most realistic demonstrations of the "Good Neighbor Policy" in action, in the opinion of Edward J. Cleary, managing editor of *Engineering News-Record*, who spoke at the joint dinner of the association held in conjunction with the sanitary engineering division of the American Society of Civil Engineers.

Mr. Cleary, who recently spent three months in South America, lauded the resourcefulness and adaptability of American engineers who have been assigned to foreign work. "Their concepts of practice required modification, they had to devise effective applications of local materials, and they had to learn to use hand labor methods of construction. The splendid manner in which they are meeting these challenges reflects much credit to the engineering profession," he said.

Succeeding Edward Smith as president of the association is William H. Larkin, division engineer of the New York State Department of Health. A. S. Bedell, secretary-treasurer, reported membership totalled 714.

The Kenneth Allen memorial plaque, awarded for the best technical paper of the year, was presented jointly to Major Rolf Eliassen, Corps of Engineers, and H. B. Schulhoff, civilian employee of the Corps, for their work on grease in sewage. This paper was published in the May, 1943, issue of the *Sewage Works Journal*.

Newkirk and Thompson slated for AWWA posts

At a meeting of the board of directors of the American Water Works Association, Samuel F. Newkirk and Leonard N. Thompson were nominated for president and vice president, respectively, of the association.

Mr. Newkirk, engineer and superintendent of the Board of Water Commissioners, Elizabeth, N. J., now holds the post of vice president of the AWWA. Mr. Thompson, long active in local affairs of the association, is general superintendent and engineer of the St. Paul water department.

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General Lee appointed deputy commander E.T.O.

As one of his first acts after assuming command of all American forces in the European Theatre of Operations, General Dwight D. Eisenhower has appointed Maj. Gen. John C. H. Lee deputy commander. General Lee, well known Engineer officer, has been chief of the Services of Supply, E.T.O., since before the North African invasion, and will retain this post in addition to his new duties. A biography of General Lee, published in *Engineering News-Record* Sept. 16, 1943, p. 431, emphasized how, even then, he was the best known and one of the most effective American generals in the E.T.O.

Another new appointment is that of Col. Royal B. Lord to be deputy chief of staff, E.T.O., in addition to his duties as chief of staff of the Services of Supply. Colonel Lord is also a former Corps of Engineers officer.

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Building code adopted by Marion County, Ind.

The first unit of county government in the United States to adopt both a land-use ordinance and a rural building code, is said to be Marion County, Ind., of which Indianapolis is the county seat. While the land-use ordinance has been in effect since 1941, it was not until last week that the building code was adopted by the County Plan Commission.

The code provides minimum construction requirements on the erection, construction, repair, alteration and maintenance of one and two-family dwellings, and of commercial and industrial structures within the unincorporated areas of the county. Claude F. Hixon, Indianapolis, is the county building commissioner.

OBITUARY

Enos Larkin Seeds, 88, partner in the contracting firm of Seeds & Deerham which built many important bridges in the Philadelphia area, died Jan. 22. He went to Texas in 1878 as surveyor and rancher. From seeds supplied by the U. S. Department of Agriculture he planted the first cotton ever raised in that state.

In 1900 Mr. Seeds returned to Philadelphia to enter the construction field. His firm built the Columbia Avenue Bridge over the Schuylkill, the Conshohocken Bridge, the Green Lane Bridge and the Fairmount Dam, all in Philadelphia, the Shrewsbury Bridge at Highland, N. J., and the Tilghman Street Bridge in Allentown, Pa.

Maj. Gen. Charles S. L. Hertzberg, an outstanding engineer and a member of Harkness and Hertzberg, Toronto, Ont., died in India recently. Mr. Hertzberg constructed the Toronto Western Hospital and Canada Life Building, the east block of the Parliament buildings and other important structures throughout Canada.

Orville Chesney, 62, bridge and building supervisor for the Southern Pacific railroad for many years, died in Medford, Ore., Jan. 8.

W. E. Callahan, 61, founder and owner of the W. E. Callahan Construction Co. of Dallas, Tex., died Jan. 5. Included in the accomplishments of his firm are Texas highways; the Mountain Creek Dam at Dallas; California's All-American Canal; St., Louis' outfall sewer project; levees on the Mississippi River; the Panama Canal Zone's Madden Dam; a $1,000,000 War Department project in Hawaii; the Nasworthy Dam at San Angelo, Tex.; Lake Kemp at Wichita Falls, Tex.; Lake Dallas at Dallas, and the $7,000,000 Southwestern Proving Ground at Hope, Ark. His firm is now engaged with others in the Canol oil field and pipeline project in Canada.

Henry R. Carter, 56, former Arkansas state highway engineer, died Jan. 9 in Little Rock, where he had lived 40 years.

Colonel Robert Roffner Raymond, 72, U. S. A. (retired), died at Cambridge, N. Y., Jan. 19. He was commissioned a second lieutenant in the Army Corps of Engineers in 1893, served in the Spanish-American War, and invented a type of cofferdam used in raising the battleship Maine from Havana Harbor. He had been in charge of river and harbor improvements at Wilmington, Del., and at Boston.

Frank A. Steiger, 79, Solano County surveyor for 37 years, died Jan. 14 in Vacaville, Calif.

J. W. Elliott, 68, for ten years associate bridge engineer of the Virginia department of highways, died Dec. 31. He was formerly a professor of engineering at the University of Vermont, and was subsequently associated with the Virginia Bridge and Iron Co. of Roanoke, and the Atlantic Bridge Co. of Greensboro, N. C.

Ira Jean Lichter, 58, of Oradell, N. J., prominent electrical engineer, died Jan. 7. In recent years he had done work at the Bermuda base, Rhode Island Naval base and in Richmond, Calif., for Fischbach & Moore.

James L. Johnson, 82, engineer with the Canadian National railroad from 1883 until 1931, died at Winnipeg, Man., Jan. 10.

Charles Robert Foran Coutlee, 78, for 39 years a civil engineer in national service, died in Toronto Jan. 1. Before his retirement in 1931 he had been engaged in almost every part of Canada, particularly on canal works.

CONTRACTS AND CAPITAL

CIVIL ENGINEERING construction volume in continental U. S. totals $33,241,000 for the week. This volume, not including the construction by military engineers abroad, American contracts outside the country, and shipbuilding, is 30 percent higher than in the preceding week, but 20 percent under the volume for the corresponding 1943 week.

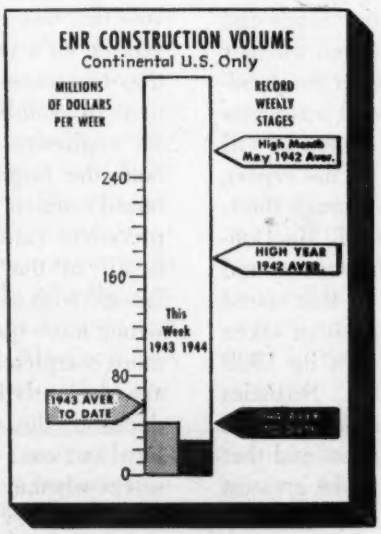
Private construction is 65 percent above last week, and gains 86 percent over last year. Public construction is up 23 percent compared with a week ago, but down 32 percent from a year ago.

The current week's construction brings 1944 volume to $179,018,000 for the four-week period, a decrease of 21 percent from the $226,826,000 for the 1943 period. Private work, $24,356,000, is 57 percent higher than in 1943, but public construction, $154,662,000, is 27 percent lower as a result of the 37 percent decline in state and municipal work and the 26 percent decrease in federal.

In the classified construction groups, gains over a week ago are in sewerage, bridges, commercial buildings, earthwork and drainage, streets and roads, and unclassified construction. Increases over the 1943 week are in sewerage, bridges, commercial buildings, earthwork and drainage, and unclassified.

New capital for construction purposes for the week totals $3,376,000, an increase of 136 percent over the week last year. The week's new financing is made up of $325,000 in state and municipal bond sales, $876,000 in corporate security issues, and $2,175,000 in RFC loans for private industrial construction.

New construction financing for the year to date, $147,172,000, compares with $4,498,000 for the four-week 1943 period.



CONTRACTS

Continental U. S. Only
(Thousand of Dollars)

	Week Ending Jan. 28 1943	Jan. 20 1944	Jan. 27 1944
Federal	$36,488	$19,863	$22,376
State & Municipal	1,349	1,095	3,379
Total public	$37,837	$20,958	$25,755
Total private	4,018	4,542	7,486
TOTAL	$41,855	$25,500	$33,241
Cumulative 1944	(4 weeks)		$179,018
1943	(4 weeks)		$226,826

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	1943 4 weeks	Cumulative 1944 4 weeks
NON-FEDERAL	$4,498	$56,340
Corp. Securities	....	47,176
State & Mun.	2,998	5,089
RFC Loans	1,500	4,075
FEDERAL	....	$90,832
TOTAL CAPITAL	$4,498	$147,172

ENR INDEX NUMBERS

Index base=100		1913	1926
Construction Cost	Jan. '44	294.57	141.60
Building Cost	Jan. '44	231.55	125.17
Volume	Dec. '43	103.	45.

EDITORIALS

VOLUME 132 NUMBER 4

January 27, 1944

Postwar Road Plans

BECAUSE ROADBUILDING makes up a considerable part of the work now being planned to help this nation through the readjustment from a war to a peace basis, it is desirable to know how far the planning for such roadbuilding had progressed up to the end of 1943. To that end, a section of this issue has been given over to postwar highway planning. Speaking generally, the showing that has been made is encouraging; certainly it surpasses anything that has been done in other fields of public work. While it is true that some states have not gone far toward having a large amount of work ready for contract when the war ends, the states where progress is most marked are those where early unemployment may develop. This is a hopeful situation and, given another six months or a year, the state highway departments as a whole should have an impressive total of work ready to be pushed directly into the construction stage.

Interregional Roads

SHORTLY BEFORE THIS ISSUE went to the press the President approved and sent to Congress a report from the National Interregional Highway Committee recommending that a 34,000-mile system of interregional highways be designated for improvement to standards set forth in the report. A brief summary of the report is given on p. 142. The system would be made up in part of existing roads and in part of new roads, depending chiefly on whether existing roads can be modernized to meet the standards set for the system. The persistent advocates of criss-crossing the country with a system of toll superhighways will be disappointed in the report, for the proposed system is to be free, though limited as to access. The hand of Thomas H. MacDonald, head of the Public Roads Administration and chairman of the committee, is seen in this sound proposal, which is in line with the position taken by the Public Roads Administration in its 1939 report "Toll Roads and Free Roads." Statistics continue to show that the greatest highway need is for the short-run travel, 30 miles or less, and that congestion around all urban centers is the greatest hindrance to such travel. Only free roads of very large capacity, which run directly into and through the centers of population, can adequately supply the chief deficiencies of the present highway system. The report recommends that they be built as part of the postwar highway building program. It deserves the hearty support of the state highway departments and city public works departments who must work for its proposals if they are to become realities.

Postwar Malaria Control

AN ANTIDOTE FOR THE HYSTERIA sweeping the country concerning widespread disease epidemics when our troops return from the war was administered by Lt. Col. Gaylord W. Anderson, Medical Corps, in his address before the sanitary engineering division of the A.S.C.E. meeting in New York last week. Analyzing the possibilities of malaria outbreaks from both theoretical considerations and actual records of past experience, Col. Gaylord could find no evidences to indicate the risk of epidemics in the United States from the presence of troops who have been infected. Engineers need this kind of realistic, professional information because they are being bombarded on every side by "scarehead" statements about postwar malaria hazards from sources not too well informed. It would be unfortunate, however, if Col. Gaylord's analysis were to be interpreted as a signal for the relaxation of future malaria control measures. The fact is that we now have far too much malaria, and the sanitary engineer is challenged to extend rather than relax his efforts in its control.

A.S.C.E. Collective Bargaining

MANY CONCLUSIONS CAN BE DRAWN from the close vote that was recorded at last week's A.S.C.E. convention on a motion to require the board of direction to reconsider its action permitting local sections to establish collective bargaining committees for engineers. We choose to regard as fortunate both the large opposition and the fact that the board's action was upheld. Great departures from precedent (and the collective bargaining program is all of that) benefit from opposition; always fraught with uncertainty, they can be proved right or wrong more quickly and, if right, they can develop more completely, when the arguments against them are constantly in evidence. In approving the board's decision, the vote upholds the autonomy of the local sections; they can continue to decide for themselves whether collective bargaining is worthwhile or unnecessary. It is they who will have to operate

the committees, and it is they who know the engineering employment conditions in their sections of the country. Presented with a problem not of its own choosing, the A.S.C.E. has acted boldly. May it be right! But if it be wrong, may it be equally bold in facing the facts and seeking another remedy.

Those False Teeth

RECENT EXCITEMENT IN CONGRESS about a set of false teeth being charged to the government under a cost-plus contract turned out to be a tempest in a teapot. The charge was quite legitimate, the teeth having been provided for a mechanic being sent to Russia, upon the recommendation of the Navy Department that men who wore glasses or had dentures be supplied with spares since replacements in Russia were out of the question. Experienced contractors know that many items go into the cost of a job that would appear questionable without knowledge of the circumstances under which they were used. Frequently, contractors pay for them out of their own pocket rather that have questions raised at some later date. The lesson to be learned from this incident is that, on government work, contractors—and the engineers who approve their vouchers—must be doubly careful not to put through charges for unusual items without making full explanation. An unexplained voucher for a set of false teeth may bring discredit on a reputation built up by years of honest effort.

Beauty in Structures

USEFUL REEMPHASIS of the fact that engineering structures should be attractive as well as safe and functional was made before one of the sessions of last week's A.S.C.E. meeting by Aymar Embury II, an architect with a well established reputation for effective cooperation with structural designers. With some justification, he charged that too many engineers still confine their design tools to a stress diagram and a slide rule. Whereas they make only a single flat drawing to show how the structure fits the ground contour, an architect makes many sketches, placing the proposed improvement in its contemplated environment for study of what best fits the location. Postwar plans for bridges and other fundamentally "engineering" structures will gain from cooperation with architects, just as fundamentally "architectural" buildings are often made less expensive or more efficient when a structural engineer has a hand in their design. Thanks to the competition sponsored by the American Institute of Steel Construction for the most beautiful bridge of the year, much has been accomplished to educate both architects and engineers as to the true basis of beauty. It is not decoration or embellishment, but proper proportion and fitness to surroundings that make a structure pleasing to the eye. Appearance as well as strength should be a criterion of postwar designs now being developed.

The Airport Challenge

SELDOM HAVE ENGINEERS been presented with a more challenging problem than that of postwar airports. The certainty of a tremendous increase in the use of the airplane, accompanied as it is by the uncertainty that surrounds the type of airplane that will be used, makes the solution of the problem much more dependent upon the exercise of judgment and imagination than upon design skill. Hence the challenge, for these are the qualities upon which truly great engineering rests. Anyone can use imagination (and insofar as the airport of the future is concerned nearly everyone does), but unless imagination is tempered with judgment and controlled by all the known facts, great financial waste and inadequacy of facilities will be the probable results.

In the field of airports, facts are meager, so it is with considerable satisfaction that one notes the program of the newly formed airport and flight strip committee of the A.S.C.E.'s highway division to assemble these facts as rapidly as possible. Also, the committee is headed by Frederick N. Schnepfe, who has been in charge of the design and construction of the twenty-six flight strips built for the Army Air Forces, and includes among its members Jay Downer, designer of New York City's great Idlewild field. Thus, the best of expert advice will be brought to bear on the problem.

Mr. Schnepfe promises that the great mass of plane operational data in the hands of the military aviation services will be obtained by the committee just as soon as possible. These, together with what is already known, should provide a firm base upon which imagination can safely operate. The postwar airport challenge can then be confidently accepted.

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Fig. 1. Typical of the rebuilt Alaska Highway is this finished section along the Prophet River, British Columbia.

Finishing the Alaska Highway

Harold W. Richardson
Western Editor, Engineering News-Record

EQUALING THE ELECTRIFYING construction performance of smashing 1,800 miles of pioneer road through the Northwest wilderness and converting it to a winter truck route in one short Arctic season in 1942, contractors last season rebuilt the Alaska Highway from end to end. The contractors' triumph is shared by the Public Roads Administration and the Army Engineers, all working together to perform a construction miracle.

While lacking the previous year's spectacular features of pioneering through unknown country, and of precarious supply lines, primitive living conditions and lack of bridges, the past year's operations were beset with such annoying difficulties as thaws, rains, floods, slides and lack of equipment, repairs and materials, which plagued the engineers and contractors at every turn. The 1942 summer dry season failed to repeat. Instead, following a winter of unusual severity, heavy rains and flash floods came with a frequency all season that astounded even the old sourdoughs and the native Indians.

● Except for completion of some of the permanent bridges the Alaska Highway has been finished as a high-class gravel-surfaced road from end to end in two short construction seasons. Army engineer troops pushed the pioneer trail through the wilderness in 1942, assisted by contractors who improved the trail into a truck route for last winter's use. Floods and thaws last spring put many miles and a large number of bridges out of service. This past season the entire route was rebuilt into a standard highway, 20 percent of the length being relocated. The 165-mile Haines Cutoff from tidewater to interior Yukon was completed by contractors working under the Corps of Engineers. Permanent metal and treated-timber culverts were installed throughout. Maintenance now is jointly by army hired labor and by contract. The following account is based on the author's second trip over the entire highway last summer and fall.—The Editors.

A year ago the Alcan Highway (as it was called before the official change of name last June) was an improved trail road, lightly graded and largely following the original contours of the ground. Drainage by thousands of temporary pole and log culverts was inadequate. Streams were crossed on temporary trestles. The gravel surfacing was thin in spots. Alignment often was made crooked to avoid bad stretches of muskeg, to weave through gulches and breaks, to approach low-level bridges in canyons, or to duck around rock outcrops in the rush to get the route through. Gradient was

ually bad in spots for like reasons. e first season's work was reported *ENR* Dec. 17 and 31, 1942, and n. 14, 1943.

Except for completion of about 20 the 164 permanent bridges, the laska Highway is now a finished ad for its full length from Dawson reek, B. C., to Fairbanks, Alaska; ll graded, properly drained and ving a deep gravel surface. Relocaons and cutoffs, aggregating 20 perit of the total length, have reduced e main route length by 100 miles to 618 miles. A 165 mile access line om Haines, on tidewater near the ad of the Inside Passage along the est Coast, now taps the highway 108 les west of Whitehorse.

Substantial, usable road

Deep cuts and high fills level off the rmer steep pitches and straighten t hairpin curves. Corrugated metal, ood stave and laminated wood-box lverts now replace the crude pole lverts installed in the pioneer road. ubstantial bridges, ranging from estles over shallow streams to the agnificent suspension span over eace River, now provide permanent ossings over half the streams; the idge job will be finished this year.

Today, as Brig. Gen. James A. 'Connor aptly expresses it, the laska Highway is a vital link in the ilitary transportation and communiation route to Alaska, which includes e Canol pipelines (to be described a subsequent article), the airways d the telephone line from Edmonton Fairbanks, completed last year. he route was designed for the comined defense of Alaska, as a lendase access to Russia via Siberia, d as a land-air route to the Aleuans in case we lost control of the orth Pacific. Naturally, its military portance decreases as the Japs are shed farther westward and the Rusans are winning on their western ont, but the route is serving its riginal purpose.

Administration changes

During the first year the Alaska ighway was primarily an Army Enneer operation. Seven regiments of ngineer troops bore the brunt of shing the pioneer trail through the ilderness. A group of contractors, orking under four managing conactors under the supervision of the . S. Public Roads Administration, was supposed to follow along behind and build a standard road on an independent location. After a few months this plan was changed and the contractors jumped over to the army trail, improving it into a suitable truck route for winter operation.

Roadbuilding in 1943 was largely the contractors' job. The four managing contractors and their associated firms, plus a few more, returned to the work. In addition, three independent contracts were let for road construction and several were let for bridges. Other bridge projects were built under the direction of the managing contractors.

Three of the seven Engineer regiments were taken out early in the winter, the other four remained for maintenance work along with a scattering of contractors. By spring, another regiment was moved north of Fairbanks to start a route to Nome that was later abandoned, one regiment was assigned to pioneer work on the pipeline road to Norman Wells, and one tackled the north end of the Haines cutoff. By August, all of the Engineer troops had been moved out, leaving all construction and maintenance to the contractors.

Meanwhile, changes were made in the administration of the project. In 1942, the PRA and its contractors, as well as the Engineer troops, worked under the general direction of the North West Service Command, with headquarters at Whitehorse. Last January, the North West Division office of the Corps of Engineers was established at Edmonton to assume control of engineering and construction work previously handled by the service command. Six district offices were set up under the division office—at Edmonton, Dawson Creek, Whitehorse, Fairbanks, Skagway and Prince Rupert, B. C., the last for improving the port and handling Alaska supplies passing through that point.

In the organization chart the division office intercepts the line of authority between the Office of Chief of Engineers and the Northwest Service Command, the division reporting direct to Washington on purely technical matters. The Public Roads Administration, still charged with completion of the standard road, did not know

Fig. 2. Route of the Alaska Highway and of connecting links in Alaska that furnish access to important military installations.

Fig. 3. Utah Construction Co. dragged supply trucks with a tractor through a 7-mile mud trench along Pickhandle Lake when the road went out with the frost.

just where it stood in the new setup. Frankly, the reorganization resulted in some confusion. For example, the PRA let a contract for building the 165-mile Haines road to L. J. Dowell, one of its managing contractors, while the division office let a contract at the same time for the same job to an independent contractor, Foley Bros., Inc. Both contractors moved onto the job and started work. This mixup was finally settled by removing the Haines project from the jurisdiction of PRA, which automatically canceled Dowell's contract. Then the PRA, as far as the Alaska Highway was concerned, was made an agency of the North West Division. On Dec. 31, 1943, all PRA functions were terminated, and full direction of the entire project passed into hands of the Army Engineers. Uncompleted PRA bridge contracts were settled; new contracts were let by the army.

Winter troubles

Despite the severity of the weather, with temperatures reaching 72 deg. below zero, the road was kept open all last winter. However, not much tonnage was hauled through from Dawson Creek to Fairbanks, due partly to the lessening of military requirements at the time, and partly to failure of the army to organize the long-haul procedure fully. The program of relay stations was not completed before cold weather set in, so there was a lack of sufficient winter housing for the troops operating the trucks, as well as inadequate weather-protected truck service and repair facilities. Yet there was all-winter service to the airports along the highway—one of the main purposes of the road.

Snow caused little trouble, and there was plenty of snow-removal equipment on hand to take care of the few bad spots in the high passes. Ice was much more troublesome. All through this north country lie underground ice sheets, even on the steep slopes. On the hillsides, especially where disturbed by sidehill cuts, they continually bleed water, which soon freezes upon striking the open air, building up ice sheets that fill the side ditches, clog culverts and pile up on the road. Constant chipping kept the road open in most places, but temporary bypasses were required in others. No permanent solution has been found for such conditions, but bigger culverts, wider ditches and raising of the roadbed all help. Some culverts were kept thawed out with live steam. Additional thawing equipment has been made available for this winter's operations in hopes of avoiding much of the trouble.

River ice also caused considerable difficulty last winter, particularly in the glacial streams of western Yukon and Alaska. Because the subsoil is permanently frozen, these shallow streams start freezing from the bottom in the fall. As a channel clogs up with ice, the stream jumps to another channel in the wide, boulder-strewn valley, thus working back and forth, building the ice higher and higher. At Robertson River in

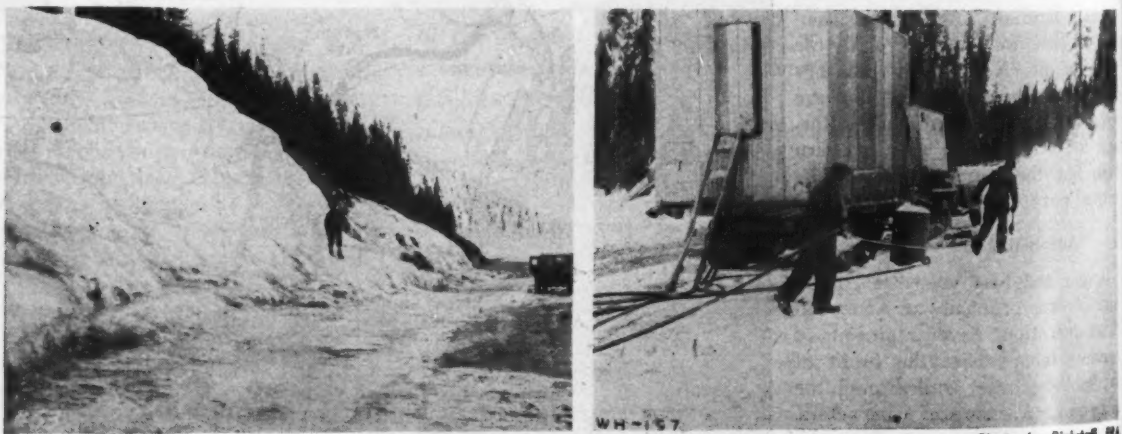


Photo by Pinkstaff, PRA

Fig. 4. Ice was much more troublesome than snow last winter. At the left ice piles up on the road in the Canadian Rockies. Maintenance forces (right) attack an icy spot with live steam from a portable boiler rig.

Alaska, for example, the ice built up to 10 ft. above the deck of the temporary trestle; the road had to be maintained on top of the ice.

Thaws raise havoc

Spring thaws raised havoc with the road in several locations, and the subsequent summer rains interfered with roadbuilding operations. Trouble was experienced in two ways: from the inadequate grade, breaking up with the surrounding soil in the thaw; and from washing out of temporary bridges and low-lying sections of road by flash floods in the streams. As had been anticipated, many of the temporary bridges were swept out by running ice, but continuous trouble from floods caused by rains was not expected.

As soon as the ice stopped running the wrecked bridges were replaced by trestles or even ponton structures in some cases, by both Engineer troops and by contractors. All through the summer the contractors were continually replacing temporary bridges taken out by floods. At one time many bridges on the entire route were out.

The permanent bridges, of course, will remove the trouble from floods; and rebuilding the road with substantial embankments carried down through the muskeg to a firm base, will eliminate further trouble from thawing ground.

One bad stretch

The worst damage from thaws was in the 90-mile stretch between Edith Creek in western Yukon, and the Alaska border, where more than half of the road went out, closing the highway to through traffic all summer. This section was the last reached by both the army and contractors late in 1942. By that time the muskeg, which dominates this part of the country, had frozen. It was impossible to remove the swampy material, as was done in some other places, and there was insufficient unfrozen fill material available to follow the established practice of filling over a timber and brush mat placed on the frozen ground. Under the circumstances, all that could be done was to clear off the trees and brush, and place a shallow surfacing fill of whatever unfrozen gravel could be found. Lacking insufficient fill cover to insulate the frozen base, the road went out with the frost early in June.

Fig. 5. Tractor and scraper builds up the grade near Whitehorse by neatly trimming the side slopes.

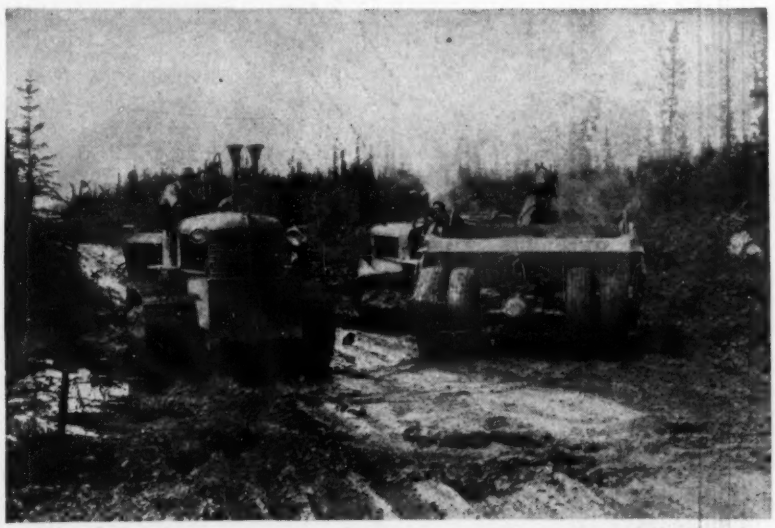


Fig. 6. Cutoffs on new locations were an important construction feature last season. Here Van Buskirk's scraper outfit builds the new road for the Tanana River cutoff and bridge approach in Alaska.

Utah Construction Co. was given an independent contract to rebuild the 150 miles of highway between Kluane Lake and the Alaska border, which included the bad stretch. This was the toughest job on the entire road last season, and it took the contractors until Oct. 15 to get the highway back into service. Meanwhile, military freight that had to go through to Fairbanks was transferred to barges at Whitehorse and shipped down the Yukon River to Circle, where it was again put on trucks for haul over the Steese Highway.

Utah was handicapped by difficulty in getting at the worst sections of that contract. The particularly bad places were a 7-mile stretch along the marsh-fringed shore of Pickhandle Lake south of the White River, and the 32 miles from the White north to Beaver Creek. Beyond the Beaver the 20 miles to the border were in bad shape from the thaw the early part of the summer. Here two companies of the 340th Engineers struggled to maintain a passable road, but frequent rains and lack of suitable equipment largely nullified their efforts.

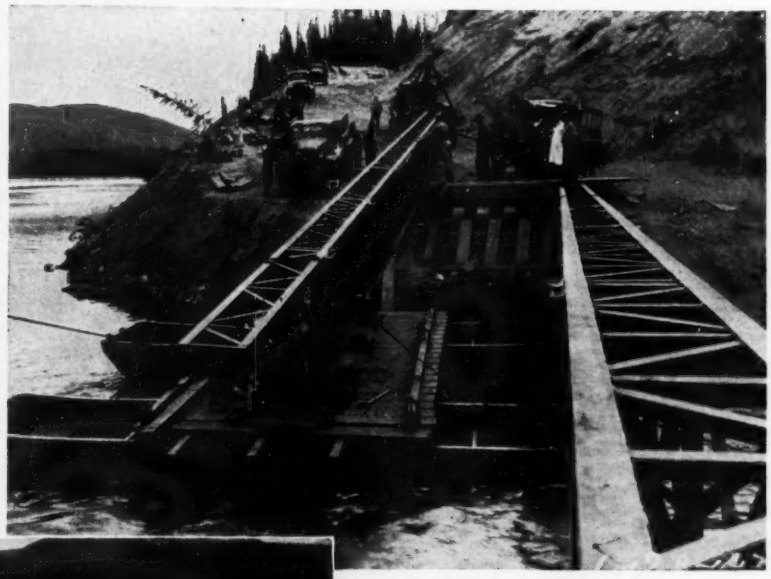
The contractor bulled his way through the mud past Pickhandle Lake with camp gear and roadbuilding equipment to get at the section beyond the White, only to be continually blocked by river floods that

A finished section of the Alaska Highway (left) on a relocated tangent stretches toward the Alaska Range in the western Yukon.

Rock shelf blasted out of the cliffs (bel along Muncho Lake in the Cana Rockies replaces dangerous, steep ro over the top of the bluffs.

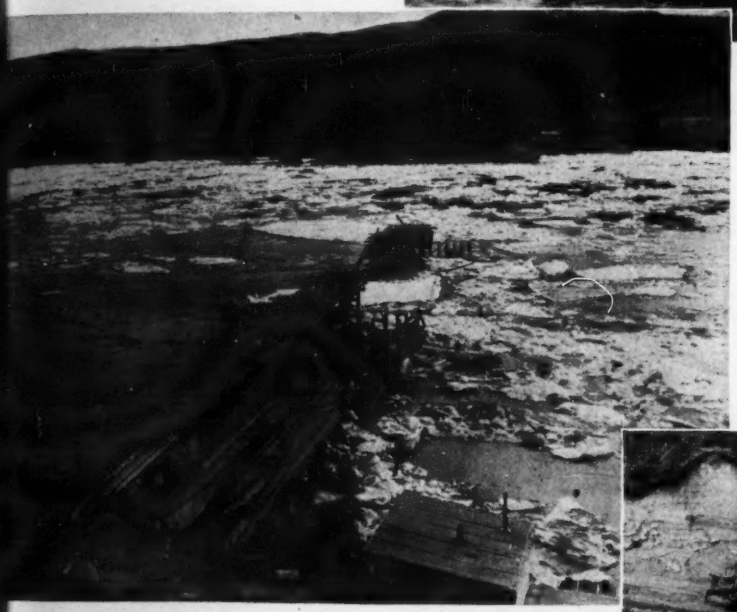
Scrapers worked Kluhini River gravel up into the grade for a riverbed route on the Haines cutoff which was adopted in favor of the old high-level route.

Substantial insulated metal huts will house many of the army troops operating transport trucks over the highway this winter. This typical relay station is at Ft. Nelson, British Columbia.



Army engineers throw girders onto pontons for a temporary H-20 bridge over the Coal River after running ice had taken out the trestle at that point.

Spring ice floes (below) raised havoc with many temporary bridges, including the long trestle at the lower Liard River crossing in British Columbia.



Heavy grading, with deep cuts and high fills, was common in the rebuilding work last season. There was no time for such heavy construction the first season.

Army engineers struggle through a stretch of bad muskeg in building the pioneer road at the upper end of the Haines cutoff. Contractors following the troops rebuilt the trail into a substantial road.

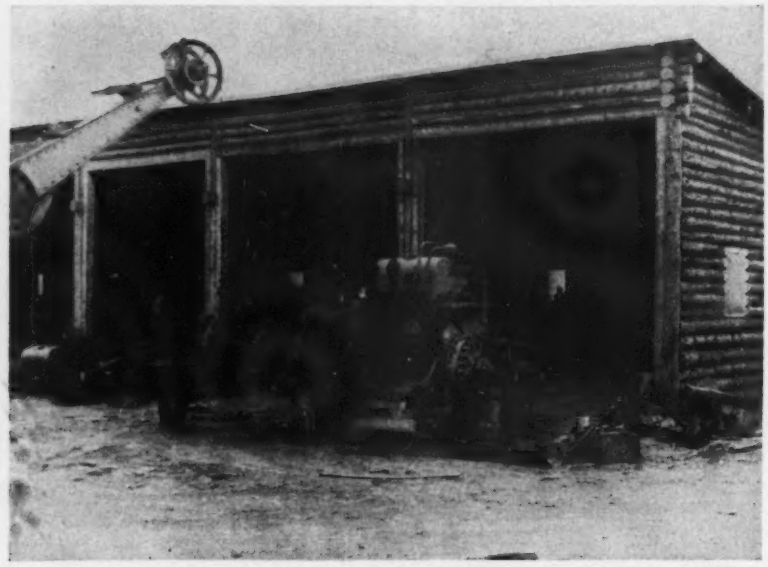


Fig. 7. Nassif repairs a tractor at his well-equipped shop in southern Yukon, typical of contractor repair facilities found throughout the job. Repair parts were fairly plentiful, with the army, contractors and manufacturers all maintaining stocks of parts.

took out the temporary bridges even before they were completed. A small camp was established on the north bank of the river, supplied by a cableway and by perilous fording of the stream by a tractor and scraper. The bad road to the south, and difficulties in crossing the river, delayed the contractor in getting equipment north of the river until late in July.

Meanwhile the Pickhandle Lake section became a 7-mile mud trench. As fast as the bottom would thaw the mud would be bladed out, thus deepening the trench until it became 6 ft. deep. Gravel is scarce in this locality, so Utah brought in compressors and drills to quarry local rock outcrops for stable material to build a temporary road. Once this access trail was built, the contractor managed to throw a rock embankment alongside the trench, which served as a side drain. Then the permanent road was placed on top of the embankment.

When the White was finally bridged, all men and equipment available were thrown onto the route to Beaver Creek. At first the contractor tried to follow the old road, scooping out the mud down to permanently frozen ground and backfilling immediately with stable materials. Later it was found more expedient to leave the original trail for a new location, and build by insulating the ground with brush and trees over which the embankment was placed. This method had the advantage of permitting equipment to operate over undisturbed ground.

Utah could work from the south end only, and by midsummer it became apparent that the job had to be carried on from the north end as well if it were to be completed before cold weather. By that time the Alaska contractors were well along with their sections, so three of them were shifted south of the border. It took the combined efforts of all four contractors to clear up the job by Oct. 15. No further trouble is expected in this area as the road is now on an embankment of stable material.

Cutoffs and relocations

Two theories of how the highway should be rebuilt were in conflict through the early part of last season. PRA, still having in mind the idea of a high-class road on an independent location, wanted to abandon the improved army trail entirely. Its engineers steadfastly maintained that it was more economical to work on a new, better surveyed, shorter and straighter route, away from the constant traffic on the original road. The army disagreed, believing the work already done should be salvaged and incorporated into the new road. They claimed PRA's long tangents and cutoffs traversed too many bad muskeg bogs, required unnecessary heavy grading, and that the independent road would take longer to build.

Obviously the answer lay somewhere between the two extremes. Certainly some sections of the original route needed to be bypassed, but others were in good shape requiring less than full construction to bring them up to standard. Finally, in June, conferences attended by the Army Engineers, the PRA and the managing contractors determined, in general, which parts of the trail were to be relocated, details being left to the three district engineers having jurisdiction over the main route. While the amount of relocated road varies from district to district, the average is 20 percent.

Haines route difficult

The so-called Haines Cutoff, that new 165-mile link from tidewater to the interior of the Yukon, was tough going all the way. Preliminary surveying and location were done by PRA last winter, but final location was made by the army after it assumed exclusive control. While Foley Bros. started at the south end, following close behind the head-end crews with a finished road, four companies of the 340th Engineers started a pioneer road from the north end, at the junction of the Alaska Highway, 108 miles west of Whitehorse. When the two outfits met in early August, the army pulled out while the contractor finished the road.

Just below the junction the cutoff crosses Dezadeash River. Here the PRA had built a 160-ft. through timber truss span, but beyond that the Army Engineers were on pioneer construction rivalling any seen on the main route the previous year. The companies spread out while the ground was frozen, then became practically isolated for a while after the thaw. The 10-mile stretch along Dezadeash Lake became impassable, so a bypass ferry was installed in the lake. Meat shortage was forgotten as the ferry crew caught enough fish by trolling on each trip to keep the head end camp well supplied. Muskeg was troublesome, requiring long sections of heavy corduroy. The swamp problem was lessened somewhat by paying more attention to drainage, a lesson learned by experience the previous year.

Haines, the southern terminus of the new link, lies on the east shore of Lynn Canal, as the upper end of the Inside Passage is called, 14 miles below Skagway. It is the site of old Chilkoot Barracks, the only military post in Alaska up to 1940. In the first six miles the road crosses the Haines Peninsula, and then follows the east bank of the Chilkat River to Kluckwan, an Indian village 24 miles from Haines. There was a crude road as far as Kluckwan, and a trail extended beyond for 18 miles more to the Alaska-Canada border, crossing the Chilkat just above the village and following along the Klehini River. This route, part of one of the old gold rush trails, was followed for the new road. Parts of it were improved to a standard road, other parts were abandoned in favor of better locations, but it did serve as an access to the lower end of the project and enabled the contractor to spread his outfits.

Foley built a base camp at Haines and several substantial camps along the first 42-mile section. Beyond that, the contractor depended largely on temporary tent camps. One long stretch of road along the Chilkat River was relocated from the tops of rocky bluffs to a shelf near water level, cut out of solid rock. Another long relocation was in the Klehini valley, where the trail on a steep hillside was abandoned in favor of a riverbed location. Here the gravel and small boulders of this glacial stream were built up into a high embankment in the river near the east shoreline.

Beyond the border the road follows the upper Klehini to M.P. 55 through wet ground, then winds up the side of the valley into the mountains, crossing the pass at El. 4,500. Occasional muskeg was found in the high country, but much of the route was fairly easy going over dry ground to where the contractors and troops met, about midway.

Grading and surfacing

Rebuilding of the Alaska Highway, both on old and new locations, involved lots of heavy grading. Wherever muskeg was found, except in the permanently frozen area, the soft material, which was seldom more than 4 or 5 ft. deep, was removed to firm foundation by bulldozer, shovel or dragline. All of the corduroy on the pioneer road, hurriedly placed that first season as a means of crossing the swamps, was torn out. Deep cuts and high fills were common as the road was leveled off and straightened out. Both scraper and shovel-truck outfits were used in grading, cutting down the humps, filling in the hollows.

Borrow pits concealed

In Alaska, the PRA followed the previous year's practice of screening all borrow pits, that is, no roadside pits were opened up. The fill material came from pits off the road, screened by timber and spaced a minimum distance apart to preserve the natural landscape.

The Alaska Highway really ends at Big Delta, Alaska, and uses the existing Richardson Highway for the remaining 90 miles to Fairbanks. This section was largely rebuilt in the past two years by the Alaska Road Commission, which also built a new cantilever steel bridge over the Tanana at Big Delta. The branch road from Gulkana, Alaska, on the Richardson Highway to Tok Junction, on the Tanana River, used as the main access route to the highway from the

Fig. 8. Scraper outfits get gravel for the subbase out of side ditches on the long tanget near Big Delta, Alaska.

Fig. 9. Shovel and trucks remove a hump on the road near Squaw Lake, Yukon.

Fig. 10. Three types of permanent culverts were installed in the finished road. Top: Sectional corrugated metal pipe fabricated to length in the Kluhini River bottoms, Haines Cutoff. Center: Laminated box of creosoted timber makes up a long culvert near Kluane Lake. Bottom: Bulldozer cuts a trench for a creosoted wood stave culvert east of Whitehorse.

Alaska seacoast the first season, was not rebuilt. Extensive maintenance and replacement of some of the bridges has kept this link as a good secondary route.

All grades were built a minimum width of 26 ft. to allow for 24-ft. gravel surfacing. For the surfacing, the intention was to use screened and crushed gravel, 1½ in. and larger for a base course and ¾ in. and smaller for the top course. However, it proved impossible to get sufficient screening and crushing plants onto the job, so much of the route is finished with pit-run gravel to a minimum depth of 12 in.

While there was a shortage of some equipment, on the whole the situation was much better than it was the first year. Shortages were severe in trucks, graders and gravel plants. As the army was also engaged in airport and flight strip construction, equipment sometimes had to be taken away from the roadbuilders and given to the runway contractors.

The parts and repairs situation was fairly good. Each managing contractor set up extensive repair shops and parts warehouses at Ft. St. John, Ft. Nelson, Whitehorse and Tok Junction. The army also maintained parts supplies at district headquarters and assigned several ordnance companies to handle parts and also to aid in keeping equipment in repair. Then too, the individual contractors usually had small shops of their own. In all, there was a smaller proportion of equipment on the deadline than there was during the previous year.

Camps and buildings

Most of the contractor camps built last year were of semi-permanent construction, designed to be utilized by maintenance crews and by army troops operating the road after the highway was finished. These camps range in construction from substantial frame and logs to metal huts and warehouses. The army also built several independent relay stations, both of frame construction and metal huts for the troops operating the road. Such stations include warehouses, garages and service and repair buildings.

Maintenance

The managing contractors, along with the Army Engineers, took care of maintenance last winter and spring. At the beginning of the summer all maintenance was turned over to the contractors, and the road was split up into maintenance sections that, in general, coincided with construction sections.

Upon completion of the road the maintenance from Dawson Creek to the Yukon border (all the British Columbia section), 640 miles, was assumed by the army. The district engineer at Dawson Creek will be responsible, hiring Canadian civilian labor and using army-owned equipment. From the Yukon border to Whitehorse, 300 miles, maintenance will be carried out under contract by the E. W. Elliott Co., Seattle, one of the independent road contractors. Utah Construction Co. has been given

contract for maintaining the road from Whitehorse to the Alaska border, 320 miles, and for the 165-mile Haines Cutoff. Lytle & Green, managing contractor for the Alaska section, will remain to take care of maintenance from the border to Big Delta, 220 miles. This outfit will also maintain the Gulkana-Tok Jct. branch, 160 miles long.

The bridge program, one of the biggest jobs on the highway, will be discussed in a subsequent article.

Permanent culverts are of three general types: sectional corrugated metal, iron-bound creosoted wood stave, and creosoted interlocking laminated timber. The corrugated metal nested sections were easy to transport and handle, and could be built to any desired length at the site. They were used mostly in the south half of the project. The wood stave culverts predominate in Alaska, while the laminated boxes were used mostly in western Yukon. Special attention was given to the backfilling over the culverts, which was tamped with pneumatic hammers

Organization personnel

Brig. Gen. James A. O'Connor is head of the North West Service Command, assisted by Col. K. B. Bush, chief of staff. They are responsible for military operations in the area and for operation of the highway and the army-leased W. P. & Y. RR. Under Maj. Gen. Eugene Reybold, Chief of Engineers, and Maj. Gen. Thomas M. Robins, Assistant Chief of Engineers, the engineering and construction operations are headed up by Brig. Gen. L. D. Worsham, North West division engineer, who replaced Col. Theodore Wyman, Jr., last March, and his executive officer Col. E. E. Kirkpatrick. District engineers have been changed frequently, but at the close of the season they were: Lt. Col. L. E. Laurien, Dawson Creek; Col. J. V. Johnston, Whitehorse; Lt. Col. Gerald R. Tyler, Fairbanks; Lt. Col. T. J. Hayes, III, Skagway; Lt. Col. R. W. Lockridge, Edmonton; and Maj. E. D. Lownes, Prince Rupert.

Under Thomas H. MacDonald, Commissioner, the PRA Alasaka Highway organization was headed by J. S. Bright, engineer in charge, assisted by Lee M. Huggins at Edmonton headquarters. Construction engineers in charge in the field included Fred Capes, Ft. St. John; Frank Andrews and Hugh Stoddard, Whitehorse; and C. G. Polk, Tok Jct., Alaska.

Contractors are listed in the following table:

ALASKA HIGHWAY ROAD CONTRACTORS, 1943 SEASON

INDEPENDENT CONTRACTORS

Utah Const. Co., Ogden, Utah; T. E. Terry, project manager; H. F. Christman, gen. supt., E. G. Pearson, proj. engr.

E. W. Elliott Co., Seattle, Wash.; R. B. Johnson, project manager; Bud Munson, supt.

Foley Bros., Inc., St. Paul, Minn.; Dave Daly and Earl Neville, project managers; Ted Ames, gen. supt.

MANAGING CONTRACTOR

Lytle & Green, Sioux City and Des Moines, Ia.; O. W. Crowley, project manager, C. C. Coykendall, field manager.

Associated Firms

Eblen & Eblen, Cumberland, Ia.
Eblen & Ekdahl, Cumberland, Ia.
E. M. Duesenberg, Clear Lake, Ia.
Ira Van Buskirk, Hawarden, Ia.
Gus Osterman, Ocheydan, Ia.
Sears Const. Co., Clear Lake, Ia.
Wm. Horrabin Contr. Co., Iowa City, Ia.
Scotthorn Const. Co., Cherokee, Ia.
V. L. Lundeen, Montezuma, Ia.
Welden Bros., Iowa Falls, Ia.
Western Engineering Co., Harlan, Ia.
L. Peterson, Cedar Rapids, Ia.
DuVall & McKinney, Logan, Ia.
Keser Const. Co., Adel, Ia.
W. B. Linnan Const. Co., Pocahontas, Ia.
Ferguson & Diehl, Jefferson, Ia.
J. Lee Hoak, Des Moines, Ia.

MANAGING CONTRACTOR

Dowell Construction Co., Seattle, Wash., L. J. Dowell and Ross Woodward, project managers.

Associated firms

Angeles Gravel Supply Co., Port Angeles, Wash.
L. L. and R. W. Byers, Los Gatos, Calif.
Gustafson & Jarvis, Sioux Falls, So. Dak.
Govan & Adler Const. Co., Port Angeles, Wash.
Haas, Royce & Johnson, San Francisco, Calif.
Joe A. Jussel, Seattle, Wash.
C. E. O'Neal, Ellensburg, Wash.
J. S. Ramstead, Seattle, Wash.
W. C. Thompson, Santa Cruz, Calif.
J. C. Dowson Co., Bellingham, Wash.
E. L. Gates & Son, Project City, Calif.
Bates & Rogers Const. Co., Chicago, Ill.
David Nassif Co., Boston, Mass.
McVaugh-Haynes Co., Center Line, Mich.
Morse Bros. Associates, Inc., Rochester, Minn.
Concrete Materials & Const. Co., Cedar Rapids, Ia.
Ulland Bros., Austin, Minn.

MANAGING CONTRACTOR

Okes Construction Co., St. Paul, Minn.; Day Okes, Wm. Bates and Chas. Palda, project managers.

Associated firms

Adolphson-Huseth-Layser & Welch, Thief River Falls and Minneapolis, Minn.
M. G. Astleford, Minneapolis, Minn.
Art Bolier, Annandale, Minn.
Brown & Leguil, Mankato and Adrian, Minn.
Cogland Const. Co., Rollo, No. Dak.
Dunnigan Const. Co., St. Paul, Minn.
Pedersen Bros., Montevideo, Minn.
Reese & Olson, Greenbush and Marshall, Minn.
Roverud Bros., Spring Grove, Minn.
Sorensen & Volden, Albert Lea and Balaton, Minn.
Southern Minnesota Const. Co., Geneva, Minn.
Standard Salt & Cement Co., Duluth, Minn.
Thomas Bros., Foley, Minn.
Volck Const. Co., Rice Lake, Minn.
Mike Welch, Minneapolis, Minn.

MANAGING CONTRACTOR

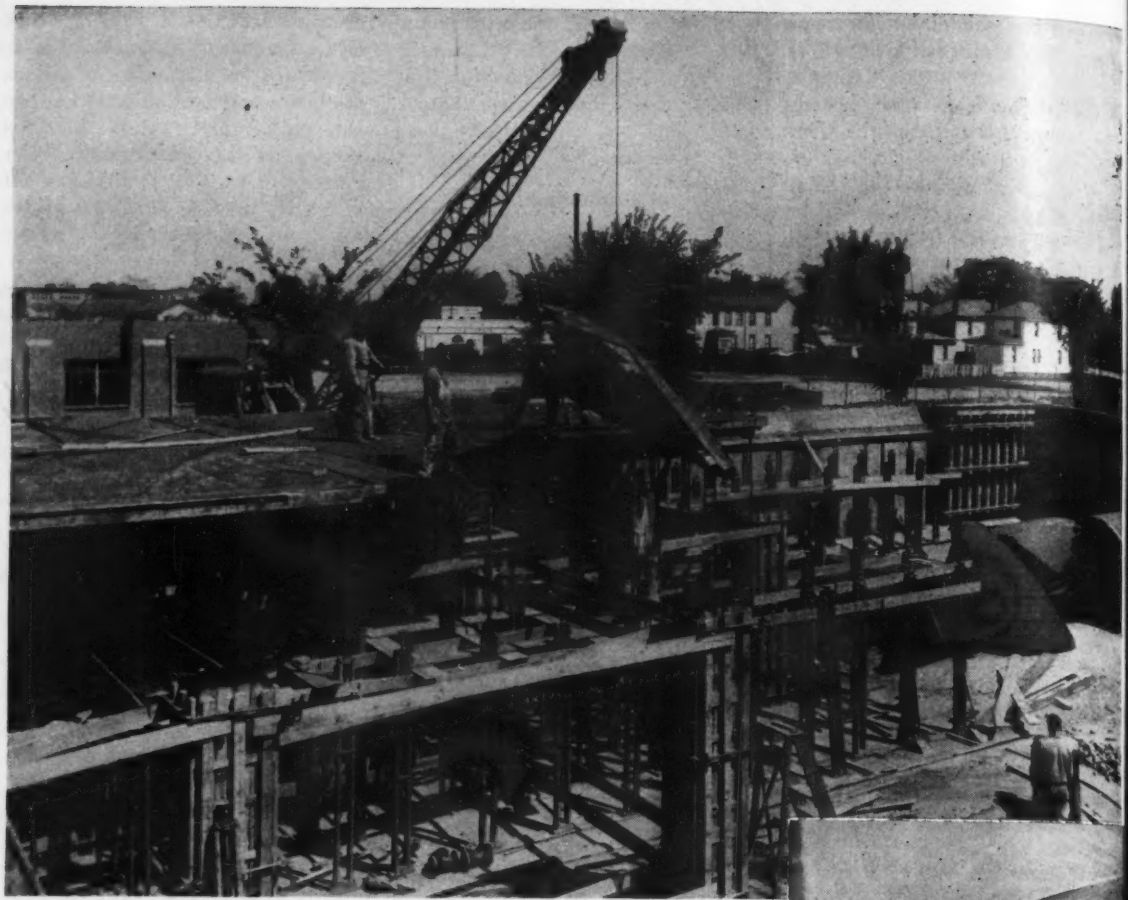
R. Melville Smith Co. Ltd., Toronto, Ont.; R. A. Campbell, manager.

Associated firms

Emil Anderson Const. Co., Ft. William, Ont.
Bond Const. Co., Kenora, Ont.
Campbell Const. Co., Ltd., Toronto, Ont.
Curran & Briggs, Ltd., Toronto, Ont.
Don Construction, Ltd., Toronto, Ont.
Dufferin Paving Co., Ltd., Toronto, Ont.
W. H. Harvey & Son, Kingston, Ont.
A. E. Jupp Const. Co., Ltd., Toronto, Ont.
Wallace A. Mackey, Ltd., Weston, Ont.
McNamara Const. Co., Leaside, Ont.
Storms Contr. Co., Ltd., Toronto, Ont.
Caswell Const. Co., Kirkland Lake, Ont.
Highway Paving Co., Leaside, Ont.
Rayner Construction, Ltd., Leaside, Ont.
Harold Harvey, Kingston, Ont.

SPECIAL CONTRACTOR ON BUILDINGS

Metcalfe-Hamilton and Kansas City Bridge Co., Kansas City, Mo.; Zan Maitland, Lee Metcalfe and Theo. Metcalfe, managers.



Placing forms for groined arched roof, which was built in alternate sections.

Interior of reservoir showing groined ceiling. Note greater thickness of floor around column base.

Cost of Plain and Reinforced Concrete Reservoirs

UNREINFORCED CONCRETE water supply reservoirs are more costly to construct—about 10 percent greater—than reinforced structures, according to data collected by the U. S. District Engineer Office for the District of Columbia, and Greeley & Hansen, Chicago consultants. This conclusion was reached upon a comparison of cost figures for two unreinforced structures recently completed in the Portsmouth, Va., area with cost data compiled for a number of older reinforced reservoirs. This comparison is summarized in Table 1.

Both of the Portsmouth projects were constructed with a minimum of critical materials and on a rush schedule. The first to be finished was the 4-mg. Godwin St. reservoir. At the time this structure was designed, reinforcing steel was regarded as extremely critical. As a result, the consulting engineers reverted to a practice of 40 years ago of designing a covered reservoir with gravity-section walls and groined arch roof.

Floor slab varies from 6 to 24 in.

For the floor a plain concrete slab varying in thickness from 24 in. under the columns to 6 in. between the columns was used. In constructing the floor and the footings great care was exercised to provide a firm foundation soil of uniform bearing value. Undisturbed earth was used.

Span of the arches is 16 ft., center to center of columns. At the crown the arches are 6 in. thick. The supporting columns are 21 in. square, which results in a 200-psi. compressive stress in the columns. In constructing the roof, forms of the type shown by the accompanying photograph were used. The roof was built in alternate sec

TABLE I—COST COMPARISON FOR PLAIN AND REINFORCED RESERVOIRS

General Location	Date built	Design	Capacity in m.g.	Cost per m.g. capacity*
rtsmouth, Va. odwin St.)	1943	Gravity walls; groned arched roof...	4	$38,978
rtsmouth, Va.	1943	Gravity walls; groined arched roof....	2	40,360
uffolk)	1942	Reinforced and covered.....	20	30,200
ashington (McMillan)	1940	Reinforced and covered.....	15	24,800
ashington oldiers Home)	1925	Gravity walls; groined arched roof....	15	30,500
econd High) ashington	1925	Gravity walls; groined arched cover...	15	31,900
oledo, Ohio	1939	Reinforced and covered.....	35	24,900
eveland, Ohio aldwin Reservoir)	1920	Gravity walls; groined arch roof.....	135	28,300

* Costs adjusted for *Engineering News-Record Index* of 290.

TABLE II—UNIT PRICES FOR PLAIN CONCRETE RESERVOIRS

Godwin St. Reservoir

Item	Cost per cu. yd.
Formed concrete, unreinforced....	$19.50
Formed concrete in groined arches.	40.00
Lean concrete — unformed.....	15.00

Suffolk Reservoir

Formed but unreinforced concrete.	$29.50
Formed concrete in groined arches.	37.00
Lean concrete — unformed.....	12.00
Soil-cement, stabilized fill.....	7.30
Excavation.....	0.87

ons, a construction joint being re- ired both ways at the crown of the ches.

Cost of the Godwin St. reservoir as $155,914 or $38,978 per each mil- n gallons of storage capacity. Unit ices based on low bids received Nov. , 1942, for this structure are given Table II.

The second reservoir to be built in e Portsmouth area is of 2 mg. pacity in the town of Suffolk, adja- nt to the filters used to filter the rtsmouth supply. This reservoir is similar in design to that just described. Construction was more expensive because large quantities of low-bearing soil had to be removed and replaced with soil-cement at a cost of $9,000. Total cost of the reservoir was $80,720 or $40,360 per million gallons capacity. Unit prices for this reservoir, based upon low bids received Sept. 29, 1942, are given in Table II.

Space will not permit a detailed description of the reinforced reservoirs listed in Table I. However, the general type of design is indicated in the table.

Construction of the two Portsmouth reservoirs was authorized by the Richmond, Va., regional office of the Federal Works Agency, Kenneth Markwell, regional director. The contractor for the Godwin St. project was C. W. Lockwood of Hampton, Va., and the contractor for the reservoir at Suffolk was the Ahlvin Construction Co. of Chicago. Greeley & Hansen were consultants on both jobs. Earl D. Covell was resident engineer for this firm.

Concrete Strength Retained In 4-Hour Mixing Test

A simple test of a single 5-cu.yd. tch of concrete mixed for 4 hr. hile samples were taken at 30-min. ervals indicated little loss of ength as measured by standard test linders broken at 28 days. The t was made by the Department of blic Works of the City of New rk and was intended as a guide on e adverse effect on slump and ength of abnormally long time mix- g in truck-mounted mixers.

It is recognized that many factors fecting the concrete were not taken to account, but the data from the one test are presented as recorded.

A blend of portland cement and natural cement (Rosendale) and Long Island quartz sand and gravel were used in a mix designed for 3,500 psi. compressive strength. Constituents of the batch, per cubic yard of concrete, were as follows:

Portland cement	535 lb.
Natural cement	80 lb.
Sand (Fineness Modulus 2.7)	1,122 lb.
Gravel (Fineness Modulus 6.8)	2,010 lb.
Water (at start).....	35 gal.

Concrete was mixed in a 5-cu.yd. capacity closed-drum truck mounted unit of a type common in New York City. The air vent in the tailgate was kept open during the mixing to avoid entrainment of air in the concrete.

Procedure was to reverse the mixer and discharge enough material for test cylinders, the same concrete first being used for a slump test. Need for more water was determined from the slump test and visual observation.

Water shown as added was that actually put into the then smaller than 5-cu.yd batch. Weights and compressive strengths shown are averages for three cylinders.

More extensive test projected

The tests were made with the cooperation of Colonial Sand & Stone Co. of New York City. Results were observed by W. S. Elliot, F. J. Howard and W. J. McFarland and reported by J. P. Kenny, all of the Materials Section, Department of Public Works, New York City. Additional and more comprehensive tests are projected, in cooperation with the commercial ready-mix plants of New York City.

STRENGTH OF CYLINDERS FOR 30-MIN. INCREMENTS OF MIXING TIME

Time of Mixing, Minutes	Water Added, Gal.	Slump, Inches	Weight 28 days Av. per cu. ft.	Strength 28 days Av. lbs. sq. in.
0.....		6.25	144.6	3,437
0.....		5.5	145.3	3,700
0.....		5.0	145.2	3,562
0.....		4.5	145.9	3,657
0.....	3	5.0	145.4	3,789
0.....		4.0	146.2	3,801
0.....	4.5	5.0	145.6	3,658
0.....		3.75	146.1	3,808
0.....	4.0	3.25	145.1	3,748
2.....	5.0	4.5	144.9	3,364

Earthquakes are only one problem in...

Building a Hospital in Ecuador

Erik Per Sorensen
Principal Architectural Engineer, Institute of Inter-American Affairs
Guayaquil, Ecuador

***Editor's Note**—Resourcefulness and adaptability to local conditions, are among the most important attributes that the engineer must have when working in a foreign country. The following story illustrates why, although the modesty of the author would cause him to deny that he possesses these special qualifications. However, a recent inspection of his work in Ecuador (ENR Nov. 11, 1943, p. 719) confirmed the fact that he is doing a job that commands the highest respect. Mr. Sorenson not only outlines his approach and solution to the construction of an earthquake-resistant hospital that had to be founded on bad ground, but makes some practical observations on the encouragement of relations with Latin-American engineers.*

AT THE RIO DE JANEIRO conference of American foreign ministers in January, 1942, inter-American cooperation was recommended in carrying out health and sanitation measures to support the mobilization of hemisphere resources and defenses. In accordance with these recommendations, the Office of the Coordinator of Inter-American Affairs in Washington set up a health and sanitation division to work with the other American republics in cooperative programs.

One of the first agreements was made with Ecuador, under which the Coordinator's office assigned medical doctors and sanitary engineers to provide technical aid to supplement the technicians and labor provided by Ecuador. The work in Ecuador centers in Quito, the capital, high in the Andes, and Guayaquil, the chief port of the country. The character of the projects to be undertaken was determined in conferences with local authorities.

Hospital construction was favored to such an extent in Guayaquil th the field party here was organized t function as a construction enterpris At present eight building project among them a tuberculosis hospita an infectious diseases hospital, a ma ternity center and a medical colleg are being built.

The structures are mainly rei forced concrete frames with bri walls. Since the foundation condi tions are rather poor and this are is subject to earthquake shock, th buildings have been designed fo horizontal loads and the foundation have been constructed so as to form rigid network of reinforced concre beams.

Tradition controlled site selection

Typical of the design and construc tion problems that had to be me were those associated with the 100-be infectious diseases hospital, for th construction of which $130,000 wa allocated.

Apparently this project had be

Fig. 1. Hospital at Guayaquil, Ecuador, which is located on filled ground over a tidal mud flat, called for the solution a difficult foundation problem. To further complicate construction, provisions had to be made for the structure to wi stand earthquake shock.

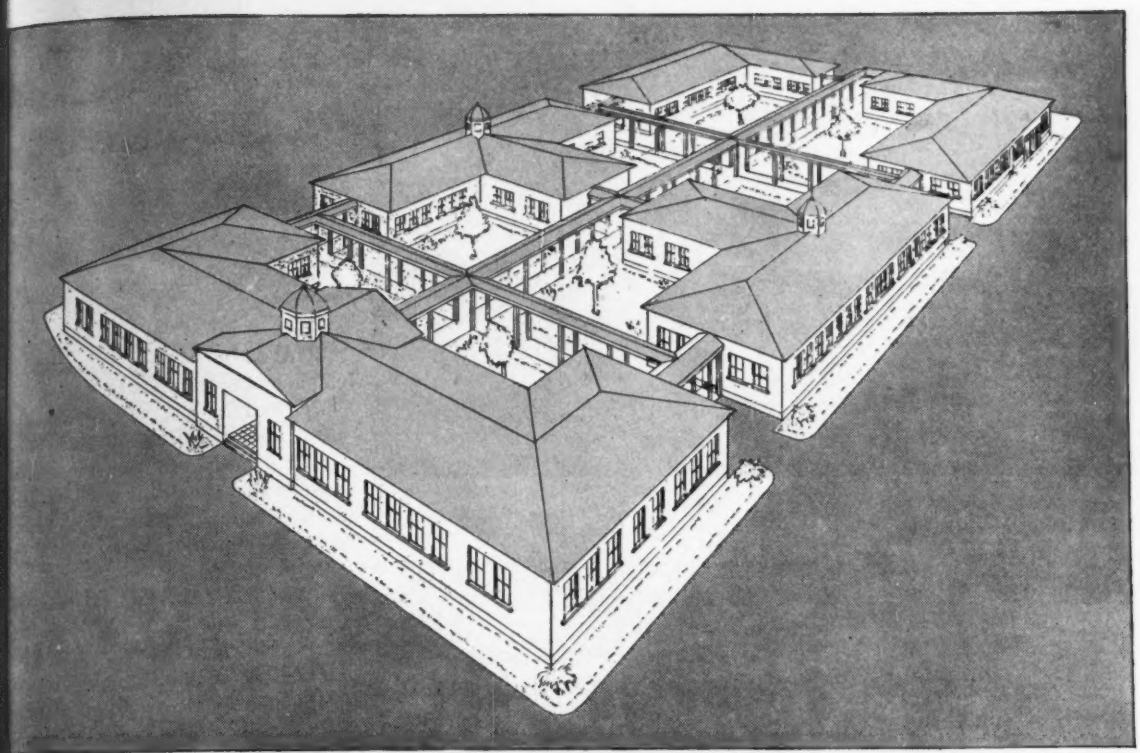


Fig. 2. General design of the 100-bed hospital for infectious diseases, whose 5 one-story pavilions provide a floor space of 35,000 sq. ft. The pavilions are laid out to enclose two patios which, in turn, are subdivided by covered passageways.

n the preferred list in Guayaquil ince the early days of yellow fever nd bubonic plague epidemics, and lthough these perils had been under ontrol for quite some time, tradition ill demanded that the project be ndertaken. Tradition also had the ospital location fixed and the site as not a particularly good one from n engineering point of view.

Another site could have been se-cted but since our instructions called r compliance as much as possible ith local preferences, it was decided give the indicated site a fair trial fore passing final judgment as to itability. An argument favoring e site was its location near the Na-nal Institute of Hygiene, a Rocke-ller Foundation establishment, hich for several years had been ing laboratory research on infec-us diseases.

Guayaquil has been built on filled d, which originally formed part a huge inland delta with its typical avy deposits of silt and soft clay. e hospital site showed the nature this land in its original form, con-ting as it did of mud flats regularly oded by an adjacent tidal saltwater er connecting to the Pacific Ocean. Test borings showed the mud to be of the thickness of 3 to 4 ft., underneath which was encountered 20 ft. of blue clay, gradually hardening with increasing depth and changing into a hard sandy clay below the depth of 30 ft.

A fill of from 6 to 8 ft. was required to bring the level of the land above high tide and to coincide with the level of adjacent roads. The site was about 350 by 150 ft., and once filled it would represent a considerable sanitary improvement of this section of the city. It was reasoned, that the fill would be justified even if the area had to be abandoned as a building site.

Fill and foundation experiences

Therefore, it was decided to place the fill during the summer and keep it under observation for settlement during the following rainy season before deciding upon actual construction. This was undertaken and it was noted that the fill—carried from the high ground in the direction of the waterway—caused the formation of a mud "wave," that was pushed out into the tidal river.

While the fill was being made an opportunity presented itself to make a large-scale experiment with the type of foundations believed to be necessary for the hospital. This opportunity arose when we were requested to build a small extension to the Institute of Hygiene, where similar foundation conditions existed. Since the original buildings of the institute had been founded on spread footings extending to the clay and had settled about six inches during a year's time, it was decided to make the new footings of a floating, reinforced-concrete beam type. These were built on top of the fill, thus exploiting the fill itself as a ballast to distribute the loads evenly over the soft material below.

As it turned out, this was a happy solution in more than one respect because an earthquake, which occurred in January of 1943, left the extension intact while it caused considerable damage to the older part of the institute.

At the end of the rainy season it was found that the fill on the hospital site had settled badly at two places due to the changing tides in the river, which had forced their entry into old stream beds and caused scour. To

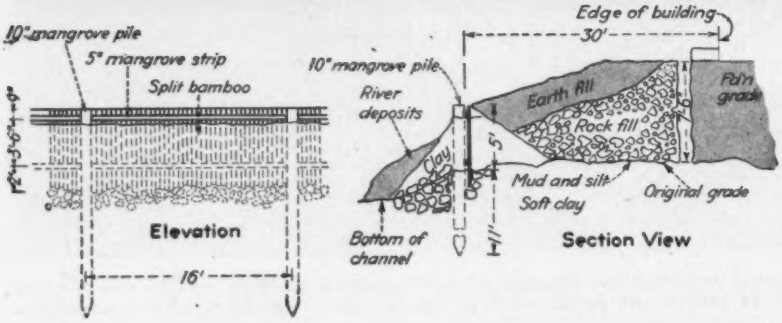


Fig. 3. Lacking wood and steel, bamboo poles split in half were used for sheet piling on the retaining wall. The method of "interlocking" the bamboo and the design of the wall are shown in the accompanying sketch.

prevent the repetition of further scour action a simple retaining wall was installed on the edge of the river.

Lacking either wood or steel sheet-piles for this purpose, a substitute was improvised by using bamboo poles split in half and rammed down as closely "interlocked" as possible. (Fig. 3). After some experimentation this wall was made impervious with clay packing, and the tidal river started cooperating by settling its own layer of impervious material outside the wall.

Design procedures

In the meantime, the design staff had completed detailed plans for the hospital itself, comprising five one-story pavilions with a floor space of 35,000 sq. ft. The pavilions were assigned to serve the following functions: One for administrative activities, three for general, private and semi-private wards, respectively, and one for service needs in which the kitchen and laundry were located. The pavilions were laid out to enclose two patios which, in turn, were subdivided by covered passageways intended for use during the rainy season.

In accordance with the experience gained from the construction of the extension at the institute the footings of the pavilions were designed as heavy beams reinforced with four ¾-in. bars in such a manner that any uneven settlement within reason would be easily carried. At the time of construction an acute shortage of reinforcing steel existed in Guayaquil but only in those sizes below ¾-in.; this size as well as 1-in. rods were available in considerable quantity. Accordingly all reinforcement had to be based on the use of large diameter bars, and the ¾ in. size was favored.

Brick was another critical material not only because the local product was homemade and of inferior quality, but also because it had to pass through so many hands on its way from the producer to the consumer that the price was entirely out of proportion to the value of the material. Furthermore, the price situation was not helped any by the circulation of rumors that our work would require some six million brick within a short time.

In order to combat this rather unhealthy condition it was decided that the design for the hospital—which originally called for the use of one million brick—should be modified to employ concrete blocks exclusively. This decision had a very beneficial effect upon the brick market because we let it be known that if prices remained above a certain maximum, the designs of all the structures in our program would be based on the use of concrete blocks.

Technically, however, the construction with concrete blocks added another problem to the many with which we had to contend on this project. Walls of concrete block were supposedly not very resistant to earthquake shock. And since Guayaquil within a year had had two quite serious earthquakes, one of which had destroyed many reinforced concrete buildings at the cost of a number of lives, this matter was of no small concern when constructing a hospital.

Earthquake resistant design

Constructing this hospital for earthquake resistance was complicated by a number of other factors. Not the least of these was the condition of the building area with its heavy layers of soft clay and silt underlying an 8-ft. layer of fill; since this acted like jelly when shaken, it could be expected that any earthquake shock would be considerably amplified at this particular site. Furthermore, the availability of reinforcing steel was limited to the extent that it could not be used too liberally in the construction of columns and tie beams.

It was finally decided that for design purposes the anticipated earthquake shock should be translated into horizontal forces equal to 10 percent of the dead load of the particular members of the structure.

From this assumption the construction design indicated in Fig. 4 emerged: The block wall was assumed separated from its foundations and given a motion corresponding to 1/10 of its dead load in its own longi-

linal direction. This called for the of concrete bulkheads at the ners of the building as indicated Fig. 4. To help each other mutu-, these bulkheads were interconcted by a tie beam, the reinforcent of which was made of one ½-in. . The tie beams had the further ction of being terminus for isoed vertical steel rods which, at ervals, were grouted into a row of ntinuous holes of the blocks to act a wall reinforcement against earthakes perpendicular to the walls.

At corners between two walls where danger existed of one wall tend- to push the other one out, these el rods were arranged in a triular pattern with hoops as shown Fig. 4. Presumably this converted hazard into an asset, namely, by ing one wall reinforce the other ll against earthquakes parallel to first one. This pattern was also d at wall crossings whenever such e not important enough to warrant air of crossing bulkheads.

To summarize, it can be said that pavilions were designed more or like a ship afloat, providing bulkds and securing the most exposed ms against horizontal forces.

Finally, it was possible to provide ght roof when a quantity of asbes-cement roofing was secured from shipment that very conveniently ived in Guayaquil from England.

A question on design

n conjunction with the design of thquake resistant construction, the ter would be very happy to receive e edification on the following nt: Western building codes seem pecify that the earthquake coeffint be applied to live loads as well dead loads. This hardly seems fair en considering actual experience ere it is evident that furniture and like move for quite some time r a shake has started, so that very n the live load is counteracting the ial earthquake.

ractically speaking, dead and live l will not be synchronized during thquakes. Therefore, it should n reasonable to assume only the er of the two acting. This, if it s justified as it appears to the er, might suggest more liberal ding codes and would involve conrable savings with regard to reinement.

Coming back to the Guayaquil job again. No contractor of any merit was disposed to take a lump sum contract under the prevailing insecure market condtions. Several offered to build under a cost-plus contract but it seemed rather difficult to reach any satisfactory agreement. Consequently, it was decided at an early stage of our program to build the projects under a force-account system. A couple of concrete mixers were rented, tools were bought and an administrative staff developed.

At present this organization has a technical staff of about fifteen local engineers and draftsmen, all of whom are nationals and a few of whom have had some experience in the United States, England or France. The writer has been the only United States engineer occupied with the work, and the fact that such an arrangement has been possible with a building program of this magnitude reflect to the greatest credit of the local engineers. Teamwork and confidence in the exchange of ideas and opinions have combined to overcome all difficulties, technical and otherwise.

Each particular job, after having been laid out, designed and estimated

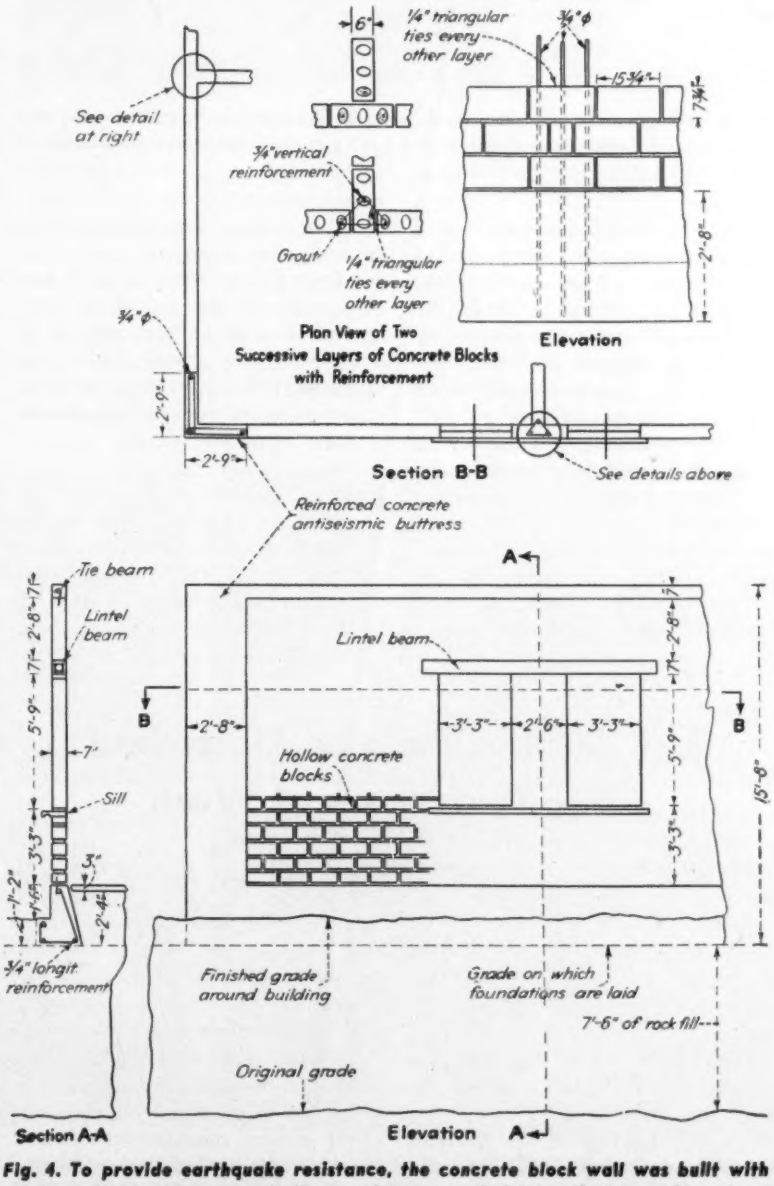


Fig. 4. To provide earthquake resistance, the concrete block wall was built with reinforced concrete corner buttresses interconnected by a tie beam. At corners between walls the blocks were fastened together with vertical reinforcement and triangular ties.

Fig. 5. Formwork for the reinforced concrete foundations. The latter are tied together to provide a rigid network of beams in case of uneven settlement of the 8 ft. fill applied over the site.

in the central office has been put in charge of an engineer who, under his own responsibility, has conducted the construction operations. Usually, the man in charge has at his disposal an engineering student from the university, who has been detailed to act as a superintendent of sorts.

This combination has caused an overhead heavier than might be the case under a different arrangement, but it has insured rigid inspection (which is very necessary in Guayaquil) as well as assisting in the general education of the parties involved. The latter result, though a by-product of the activities of the Coordinator's Office, has been greatly appreciated by the local people. This is evidenced in part by the fact that many local university students have offered to work without compensation for an opportunity to participate in what they consider a practical supplement to their scholastic training in engineering.

When considering this in conjunction with the writer's experience that the majority of Ecuadoran engineers are very resourceful, it is suggested that opportunities might be given to many of these engineers for practical training under similar circumstances in the United States. For example, large companies might consider the temporary employment of one or two Latin-American engineers as apprentices, with results that would be mutually satisfactory.

This proposal, which at first may sound naive, has a background of realistic fact, since the writer personally knows of young Ecuadoran engineers who would be only too willing to work hard in the United States just to learn our way of doing things. At the same time there are engineering and equipment firms in the United states who are looking for people who can speak Spanish and are familiar with conditions "south of the border." Opportunities for some form of mutual assistance might easily be worked out. (Editor's Note: In this connection see a letter from Alberto Belaunde G., a Peruvian civil engineer, published in *ENR* July 15, 1943, p. 129).

Acknowledgment

The hospital program at Guayaquil is under the guidance of the Health and Sanitation Division of the Office of the Coordinator of Inter-American Affairs. Col. Albert R. Dreisbach, M. C., is director of the division, and Maj. H. B. Gotaas is assistant director and chief engineer.

Capt. Wyman R. Stone is chief of the Ecuador field party, and the writer is in charge of the program at Guayaquil.

Switzerland Railway Electrified After Two Years of Work

The 60-mi. long scenic Furka-Oberalp railway in Switzerland has been electrified. Due to the war and its ever increasing coal shortage electrification was decided on in 1940. The work was completed but a few months ago.

The railway is of the narrow-gage. Construction of the line started in 1911 and because of interruptions during the 1914-1918 World War was not completed until 1925. Over 50 viaducts and bridges, a number of avalanche galleries, and twelve tunnels were required. Although Switzerland is a land of electrified railways, the new line was not electrified because the railway is at high altitude where yearly removal of much of the electric installations in the autumn and resetting in the spring was considered necessary.

Removal of the contact power line and poles recently installed is expected to be necessary during the winter on one mountainous stretch. However, the line and poles are designed to permit rapid installation again in the spring.

Two types of hauling vehicles are used on the railway. For hauling of heavy passenger and freight trains, 1,400-hp. locomotives with four axles and four driving motors are used and for light passenger traffic, rail cars with four axles and two driving motors of 650 hp. are employed. All locomotives and rail cars are fitted with adhesion and rack drive.

An electric rotary snow plow is used in winter to clear the tracks. This vehicle is fitted with two turbines and is driven by 500-hp. motors; the locomotive propelling the snow plow furnishes the necessary electric power. The plow is capable of clearing away the snow up to a height of over 8 ft. and it can remove as much as 7½ cu.yd. of snow per second.

Second Curve in Plates by Controlled Heat

This method of bending steel ship plate has cut fabrication cost as much as 70 percent at a Pacific Coast yard.

TO MAKE THE IRREGULAR CURVES along the longitudinal length of a vessel in addition to the transverse curve that is required in many bilge plates, Gerry Ross, flange fitter foreman of the Everett Pacific Company, has developed a method of bending that cuts fabrication cost by 70 percent. The plate first is given its required bend in the long direction on rolls then, by heating along its edges, it is "dished" without changing the radius of the previously rolled bend.

A No. 5 tip oxyacetylene flame is used, the width of the heating along the plate regulating the amount of the "fore and aft" bend that the plate will have. The method can be used on galvanized steel as well as black, care being necessary only in moving the heat before the galvanizing melts. Holding the torch 6 in. from the work permits the heat to penetrate with less danger of damaging the galvanizing.

Only simple tools required

No tools are necessary other than the torch and the pattern of the bend. The plate is supported at each end on blocks, the center of the plate being free to sag. Heat is applied on the side to be concave and at the inner end of the bend first, working gradually outward and heating to a cherry red on both edges of the plate. The plate will bend in the opposite direction first but as it cools, will come to the desired position. No formulas other than experience is offered for the amount of heat needed. If it is not sufficient on the first pass, more bend can be given the plate by widening the heat area.

This method of flame shaping eliminates the bending of the plate on the usual fabricated die placed in a hydraulic press. Where bent over a die, heat used must be applied to the opposite side of the plate from that which will have a natural tendency to bend to the desired shape. Thus the plate must be hammered and forced into position putting the plate in a permanent strain. Bending by heating avoids "locked up stresses" in the plate.

Curved bilge plates up to 48 in. x $\frac{9}{16}$ in. x 20 ft. have been given as much as a 4-ft. rise from a flat corner to the diagonally opposite corner of the plate by this method.

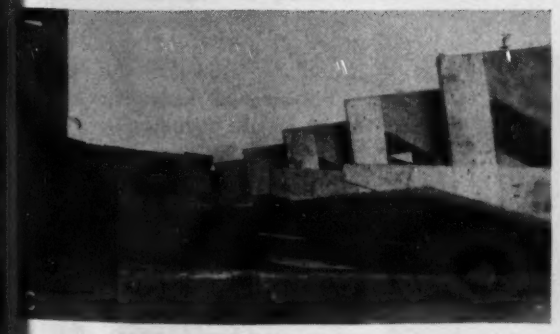


Plate is supported only at the ends and a weight placed in the center to partially control the expansion. (A) Heat is applied in marked area; note conformity of bend to template. (B) Convex bend occurs from expansion. (C) During cooling end becomes concave but original longitudinal bend remains true. (D) Plate fits perfectly on ship frame eliminating strain and use of pulling devices. Gerry Ross, flange fitter foreman for Everett Pacific Co. and developer of the scheme in the foreground.

Ordnance Depot Uses Rock Salt To Help Free Roads of Snow

***Contents in Brief**—Rock salt is being used in large quantities to keep roads and working platforms at a northern ordnance depot free of ice and snow. Salt is spread over pavements soon after snow begins to fall to keep accumulations from freezing to the surface and to facilitate the work of the plows. Similar treatment is applied to platforms at munitions igloos.*

EXTENSIVE USE of common rock salt is being made at the Seneca Ordnance Depot to keep the heavy snows of the region in which it is located from interfering with the free flow of munitions to the armed forces. Salt is used both on roads and loading platforms to facilitate the work of snowplows and to eliminate accidents due to slippery pavements.

The Seneca Ordnance Depot is located in a region where the snow fall may range from 40 to 100 in. per season. Within the reservation there is the equivalent of 116 miles of 16-ft. wide pavement to be kept safe and accessible through every hour of the day and night. In addition, there are 35 miles of unimproved roads to be cleared.

Based on last winter's experience, 21 pieces of specialized snow removal equipment have been provided to keep the roads clear for the greater volume of munitions to be moved this year. Included are rotary snow throwers. Several standard pieces of snow removal equipment have been specially rigged by machinists at the depot to adapt them to army motive power.

A special snow-fighting map shows the priority rating of roads for the assignment of equipment. Also indicated on the map is the location of the salt storage boxes throughout the base. These boxes are covered, of wood construction, 3x4x6 ft., each filled with a ton of rock salt before the opening of winter. They are placed at strategic points so that a maximum amount of salt can be applied early in the course of the most intense storm, saving time and wear on trucks which otherwise would have to return from distant parts of the area to the central salt storage bins. Last year, 240 tons were spread on the roads of the depot.

The main salt storage bins, of 300-ton capacity, are located at the railroad siding to facilitate delivery direct from cars by mechanical loaders. Hoppers are provided so that six trucks can be serviced simultaneously if necessary. Grade CC rock salt is used.

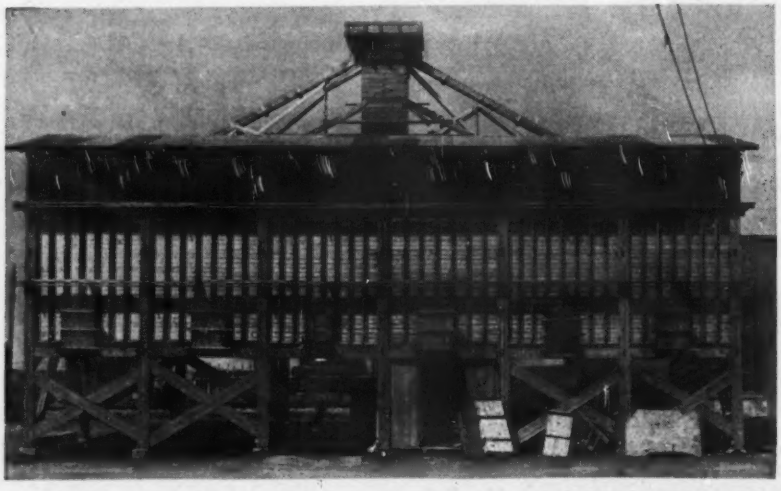
At the beginning of a storm, as soon as the pavement is covered, trucks load up at the salt hoppers and move to their assigned areas. From the back of the slowly patrolling trucks, men with shovels spread the salt down the center of the crowned roads at the rate of about one-quarter pound to the square yard. This application prevents any ice formation because, as the salt dissolves forming brine, the freezing temperature is lowered and the mass remains in a mealy condition. No blanket of snow adheres to the pavement because the brine melting through the snow breaks the bond and the plows generally can remove the accumulation down to bare pavement in a single trip. The more narrow bituminous-top service roads have a crown which permits a portion of the brine to permeate the snow at the sides of the treated strip so that a bare surface can be obtained for the entire width of the road from shoulder to shoulder. Large trucks in meeting on these narrow roads thus can pass each other in safety.

Aprons in front of the numerous storage igloos must be kept clear to permit easy access of loading and unloading trucks. The transfer is often accomplished largely by manual labor, which makes it necessary to protect against the risk to life and property involved in missteps on slippery pavement. Bare surfaces also are maintained at railroad sidings.

On the loading platforms in the warehouse area precautions are also taken to prevent ice formation and remove snow rapidly. Salt is spread here at the rate of one-half to three-quarters of a pound per square yard to effect removal of ice and snow in the shortest possible time. The concrete platforms are wide enough to accommodate small plows which can proceed up ramps at either end of the structure to clear the entire length rapidly. Snow loaders remove deposits that cannot be pushed out of the way with power graders.

Shipment of materials of war destined for the fighting fronts is only one of the functions the depot performs. Incoming shipments from arsenals and munitions factories must be repacked, classified and placed in storage. Constantly changing tactics of warfare shift the emphasis to different categories of munitions and dictate a considerable amount of restorage work.

Snow fighting at the Seneca Ordnance Depot is under the direction of Capt. Robert E. Witt, post engineer.



Salt-storage bins having a total capacity of 300 tons are designed to serve six trucks simultaneously.

PLANNING FOR

Postwar Highways

OSTWAR HIGHWAY PLANS ANALYZED

V. T. BOUGHTON
Associate Editor, Engineering News-Record

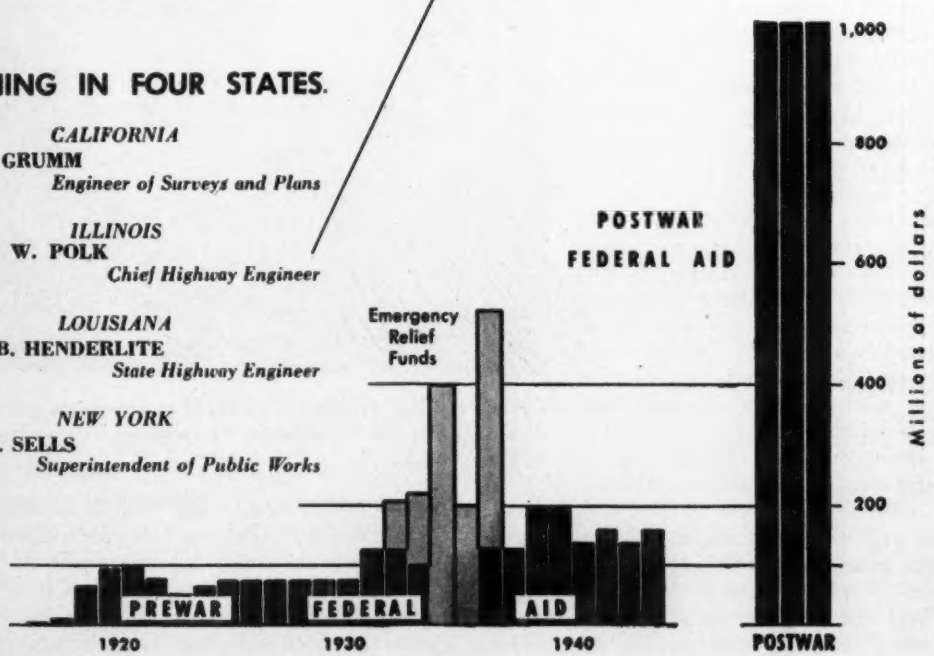
PLANNING IN FOUR STATES.

CALIFORNIA
FRED J. GRUMM
Engineer of Surveys and Plans

ILLINOIS
WESLEY W. POLK
Chief Highway Engineer

LOUISIANA
HARRY B. HENDERLITE
State Highway Engineer

NEW YORK
CHAS. H. SELLS
Superintendent of Public Works



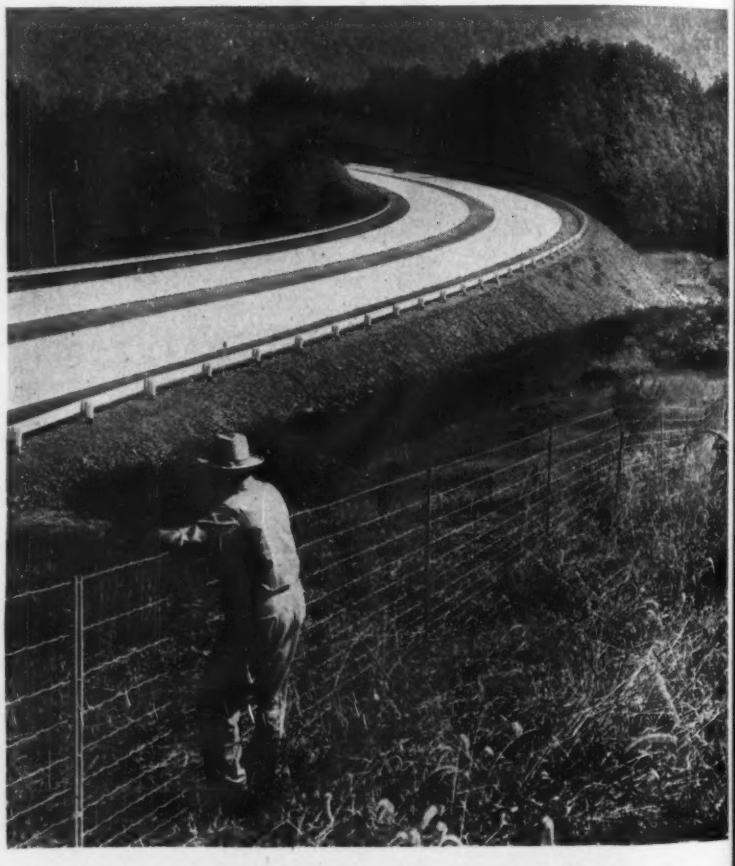
Postwar Highway Plans Analyzed

V. T. Boughton
Associate Editor, Engineering News-Record

Contents in Brief—*Planning for postwar highway building now centers on making up the serious deficiencies in the nation's highway system while at the same time providing a large reservoir of quickly available jobs for men from the military forces and war industries. Estimates of the amount of highway work that should be undertaken run as high as three billion dollars a year, and needed work estimates total fifteen billion. Concentration of need in urban areas raises question as to the desirability of changing the system of apportioning federal aid among states. Considerable work remains to be done on plans and estimates before sufficient work for the first year will be ready for contract when the war ends.*

PLANNING FOR POSTWAR HIGHWAY work is not being put into concrete form at anything like the desired rate due to failure on the part of many highway authorities to realize that the postwar program must be something other than an expanded prewar program. Federal-aid programs of prewar years were based on the assumption that highway needs were distributed over the country in a fairly uniform manner, hence the funds made available to the states should be apportioned on some uniform basis. That theory was made out of date before the war by the mounting concentration of highway needs in urban areas; it will be even less applicable to the immediate postwar period because of peculiar conditions that will prevail at that time.

Two objectives must be met in planning for postwar highway construction. First, the rapidly mounting deficiencies of the present highway system must be made up as quickly as possible, regardless of their location; and second, the highway building industry must be ready to provide quickly the greatest possible reservoir of useful employment to facilitate the readjustment of our economic system after the war. Therefore, the questions that must be answered in drafting a postwar highway program are: What are the urgent needs that must be supplied and where is the work located; how much additional work can be undertaken to provide employment should serious unemployment develop, and where will the unemployment be most likely to be found; how much employment can the road-building industry be expected to produce; and how quickly can work be got under way when military demands have been reduced to the point where civil construction can be resumed. Finally, there must be a determination of how to allocate federal aid to meet both the urgent highway needs and possible unemployment. Unless sufficient work is planned for those regions where unemployment is expected to develop, the highway-building industry will not be able to meet its full responsibility in reducing unemployment.



Postwar highway designs will be based on experience gained in the prewar years. Here shown is the Pennsylvania Turnpike, an outstanding example of advanced highway design.

Another question to be answered is the amount of construction equipment and the number of contractors that will be available immediately following the war, for on that will depend in large part the size of the first year's program after the war.

In the following, the current postwar highway plans and the public

statements of leaders in the highway field are reviewed to determine to what extent they answer some or all of these questions.

How big a program

Thomas H. MacDonald, head of the Public Roads Administration, states that replacing seriously depreciated highway facilities will require the following annual expenditures "over a substantial period of years":

Highway construction	$1,690,000,000
Highway maintenance	845,000,000
Total	$2,535,000,000

The standby program to be used if unemployment develops, Mr. MacDonald states, should at least provide as much employment as was provided by the WPA highway projects and the PWA road and street projects in the prewar depression. He sets the cost at $1,557,000,000. If the program of needed work is put under way simultaneously with the standby program the total will be:

Urgently need highway construction	$1,690,000,000
Standby highway program	1,557,000,000
Total	$3,247,000,000

Within the last few days the President sent to Congress a report proposing an expenditure of $750,000,000 on interregional highways, details of which are given on p. 142 of this issue. Presumably, this proposed expenditure is included in Mr. MacDonald's figures as he was chairman of the committee that prepared the report.

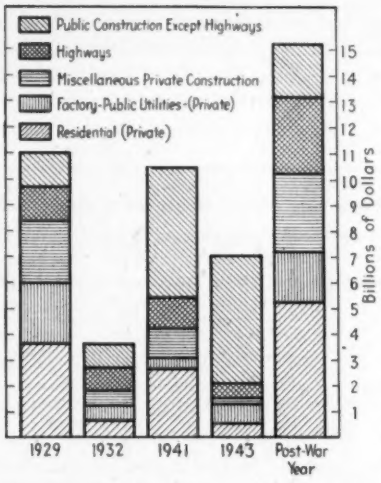
The A.R.B.A. program

Most widely discussed of the postwar highway programs is that of the American Road Builders Association, contained in its pamphlet "A Sound Plan for Postwar Roads and Jobs," which is based on a study of the relation of general construction to the national economy in past years, with special emphasis on the part that general construction has played as a stabilizer.

Past experience, according to the A.R.B.A. study, has shown that in times of prosperity the construction investment has ranged from 12 to 15 percent of the national income. Assuming that in the postwar period the national income will rise to somewhere between $105 billion and $120 billion, the A.R.B.A. study sets the needed construction expenditure at $15 billion. Of this amount, it estimates that $3 billion should be spent annually on highways. This would be broken down as follows:

State highway systems	$1,100,000,000
Urban area highways	1,000,000,000
City streets	500,000,000
County and local roads	400,000,000
Total	$3,000,000,000

This is twice the amount spent in 1930 when, to create employment, funds spent on roads reached an all-time high of $1,500,000,000. The 1926-33 average expenditure on highways was $1,348,000,000. The largest increases in the A.R.B.A. plan are on the state highway systems and on highways through metropolitan areas. Proposed expenditures on local roads and city streets are not far out of line with those of prewar years.



Construction in the postwar years should total to over 15 billion dollars annually, according to the American Road Builders Association, of which three billion will be highway work.

Highway officials program

Legislation introduced in Congress in 1943 at the request of the American Association of State Highway Officials (HR 2426) calls for an annual expenditure of $1,000,000,000 by the federal government for each of the first three years immediately following the termination of the war. One-half of this is to go to the states for expenditure on the federal-aid system and one-half for expenditure on roads in urban areas and on secondary and feeder roads in rural districts. This federal money, according to the present provisions of the bill, is to be matched on a 75 percent federal-25 percent state basis, or one state dollar for each three federal dollars, which is a change from the 50-50 matching that has been in effect on normal federal-aid highway work since 1916. When matched by local money on the 75-25 basis, this federal money will provide a total program amounting to the following:

State highway systems	$660,667,000
City streets County and local roads	666,667,000
Total	$1,333,334,000

This is somewhat less than half the A.R.B.A. program for the same three postwar years.

The large increase in federal aid over prewar years as proposed under the A.A.S.H.O. program is shown in the chart reproduced on the cover of this section, which was prepared by the Connecticut State Highway Department.

When HR 2426 comes up for hearing in Congress, it is expected that the A.A.S.H.O. will ask Congress to add $250,000,000 annually for three years for expenditure on roads in urban areas. This federal money, plus local funds on a 75-25 matching basis, would produce $333,330,000 of additional work, bringing the total up to $1,666,666,000 a year for three years. This, it will be seen, coincides closely with Mr. MacDonald's figure of $1,690,000,000 for the needed highway program for several years following the war.

If, on the other hand, Congress insists on a return to the 50-50 matching of the long established federal-aid highway program, the total money available for expenditure in each of the three years following the war would be considerably increased. Including the projected $250,000,000 a year additional for roads in urban regions, the figures would stand as follows:

State highway systems	$1,000,000,000
City streets County and local roads	1,000,000,000
Urban area roads	500,000,000
Total	$2,500,000,000

This figure closely approaches the A.R.B.A. figure in urban areas.

Available work

Programs of the magnitude of any of those outlined in the preceding can only be undertaken efficiently if that amount of proposed new highway construction is needed and if plans,

specifications and contract drawings are ready for the start of the first year's program when current war restrictions are taken off of highway construction. To determine what work is required, the American Association of State Highway Officials, in the fall of 1943, asked the state highway departments to report to the association as to the amount of needed highway work on their state systems. The replies, as published in the October, 1943, issue of "American Highways," journal of the A.A.S.H.O., indicate that the available work will cost slightly over $7 billion. Included is construction, reconstruction or widening of 158,500 miles of highway and

TABLE I—AVAILABLE POSTWAR WORK ON STATE HIGHWAYS AND BRIDGES, LOCAL ROADS AND CITY STREETS.
(Based on surveys made by the American Association of State Highway Officials and Engineering News-Record)

State	HIGHWAYS			BRIDGES		Total Highway and Bridge Construction and Reconstruction A.A.S.H.O. and ENR Reports	Amount of federal aid allocated to each state during the Three-Year Postwar Period under the A.A.S.H.O. Program
	Needed State Highway Construction or Reconstruction A.A.S.H.O. Reports	Municipal Street Work ENR Reports	County and Local Roads ENR Reports	Needed Bridge Work on State Highways A.A.S.H.O. Reports	Municipal Bridge Work ENR Reports		
Alabama	$54,030,000	.....	.....	$3,502,000	.....	$57,532,000	$64,200,000
Arizona	45,650,000	.....	.....	2,800,000	.....	48,450,000	36,000,000
Arkansas	101,636,000	$1,044,000	.....	32,000,000	$534,000	135,041,000	50,400,000
California	153,390,000	188,469,000†	$4,673,000	15,400,000	3,609,000	365,541,000†	130,500,000
Colorado	75,620,000	.....	.....	2,884,000	.....	78,504,000	47,700,000
Connecticut	221,220,000	2,500,000	.....	22,100,000	717,000	246,517,000	23,700,000
District of Columbia	.....	.....	.....	.....	.....	.....	15,000,000
Delaware	12,132,000	.....	.....	2,910,000	.....	15,042,000	15,000,000
Florida	98,227,000	6,249,000	3,700,000	17,616,000	8,461,000	134,253,000	43,800,000
Georgia	85,428,000	.....	.....	7,500,000	.....	92,928,000	75,300,000
Idaho	21,280,000	.....	.....	2,480,000	.....	23,760,000	31,500,000
Illinois	150,550,000	2,000,000	1,997,000	32,605,000	25,000	187,177,000	134,700,000
Indiana	126,704,000	16,949,000	1,571,000	34,157,000	8,222,000	187,603,000	74,400,000
Iowa	156,120,000	625,000	.....	26,300,000	4,134,000	187,179,000	71,400,000
Kansas	146,740,000	.....	.....	30,710,000	.....	177,450,000	68,100,000
Kentucky	65,193,000	.....	.....	10,329,000	.....	75,522,000	58,800,000
Louisiana	134,000,000	.....	.....	14,000,000	.....	148,000,000	47,400,000
Maine	35,000,000	605,000	.....	4,230,000	55,000	39,890,000	24,600,000
Maryland	63,574,000	20,000,000	.....	22,572,000	.....	106,146,000	29,100,000
Massachusetts	121,000,000	1,300,000	.....	*	715,000	123,015,000	54,000,000
Michigan	334,173,000	105,474,000	.....	5,836,000	54,826,000	500,309,000	99,000,000
Minnesota	197,914,000	5,450,000	4,261,000	15,414,000	1,421,000	224,460,000	77,700,000
Mississippi	70,579,000	.....	.....	6,700,000	.....	77,279,000	53,400,000
Missouri	33,322,000	77,804,000	.....	8,062,000	17,496,000	136,684,000	89,400,000
Montana	66,100,000	.....	.....	7,500,000	.....	73,600,000	49,800,000
Nebraska	55,950,000	.....	.....	10,500,000	.....	66,450,000	53,400,000
Nevada	36,358,000	.....	.....	1,691,000	.....	38,049,000	30,000,000
New Hampshire	21,900,000	.....	.....	1,930,000	.....	23,830,000	15,000,000
New Jersey	146,906,000	8,591,000	.....	46,684,000	1,000,000	203,181,000	52,500,000
New Mexico	70,498,000	.....	.....	15,500,000	.....	85,998,000	40,500,000
New York	515,000,000	58,070,000	2,563,000	25,000,000	17,137,000	617,770,000	185,700,000
North Carolina	59,400,000	2,701,000	.....	16,300,000	2,309,000	80,710,000	75,300,000
North Dakota	66,200,000	.....	.....	8,000,000	30,000	74,230,000	38,100,000
Ohio	499,700,000	20,716,000	13,600,000	80,300,000	87,128,000	701,444,000	119,400,000
Oklahoma	110,000,000	.....	.....	25,000,000	.....	135,000,000	65,400,000
Oregon	137,000,000	100,000	735,000	13,000,000	300,000	151,135,000	44,100,000
Pennsylvania	409,004,000	51,011,000	13,620,000	40,764,000	19,957,000	534,356,000	149,100,000
Rhode Island	13,705,000	.....	.....	2,575,000	25,000	16,305,000	15,000,000
South Carolina	49,000,000	600,000	.....	8,500,000	.....	58,100,000	41,700,000
South Dakota	57,924,000	.....	.....	3,666,000	80,000	61,670,000	39,900,000
Tennessee	138,000,000	2,150,000	.....	12,000,000	.....	152,150,000	65,100,000
Texas	730,000,000	12,447,000	6,432,000	100,000,000	4,895,000	853,774,000	181,500,000
Utah	48,600,000	.....	.....	5,500,000	.....	54,100,000	27,100,000
Vermont	20,270,000	.....	.....	3,155,000	.....	23,425,000	15,000,000
Virginia	103,991,000	9,900,000	.....	6,762,000	2,816,000	123,469,000	57,600,000
Washington	45,100,000	5,840,000	.....	20,100,000	4,742,000	75,782,000	46,200,000
West Virginia	159,300,000	.....	.....	20,000,000	.....	179,300,000	36,000,000
Wisconsin	140,000,000	3,026,000	559,000	13,000,000	7,670,000	164,255,000	72,900,000
Wyoming	15,000,000	.....	.....	1,500,000	.....	16,500,000	30,000,000
Totals	$6,218,395,000	$603,621,000	$53,711,000	$809,034,000	$248,104,000	$7,932,865,000	$2,961,400,000
				6,218,395,000		Hawaii	15,000,000
						Puerto Rico	21,600,000
			Total work reported by the A.A.S.H.O.	$7,027,429,000		Total	$2,998,000,000

*Included in road mileage cost.
†Possibly some duplication in state and municipal.
Figures given in columns 1 and 4 are from a compilation made by the American Association of State Highway Officials as published in *American Highways*, October, 1943.

30,000 bridges. Grade separation work is included in the work reported by some states.

The A.A.S.H.O. total figures for the states are given in columns 1 and 4 in Table I. If properly distributed geographically, the work covered by this tabulation would be more than adequate for the program called for under the legislation now in Congress.

A.R.B.A. survey

Charles M. Upham, engineer-director of the American Road Builders Association, reports that on Jan. 1, 1944, 42 of the 48 states had submitted figures to the association totaling $7,101,000,000 for postwar construction on highways, bridges and grade separations. This money will be required for construction and reconstruction of 133,000 miles of highway and 16,000 bridges.

Replies to the A.R.B.A. questionnaire further indicate that by Jan. 1 of next year 24 states will have projects amounting to $967,000,000 for which rights-of-way will have been obtained and plans will have reached the contract stage. Projects without rights-of-way obtained, but otherwise ready for letting by Jan. 1, 1945, will amount to $396,000,000 in 28 states. This gives a total with and without rights-of-way of $1,364,000,000 in 33 states. States reporting, together with their programs, are listed in Table II.

The wide discrepancy between the figures for the total postwar construction program of some states in this report to the A.R.B.A. and those reported to the A.A.S.H.O. is as yet without full explanation. The A.A.S.H.O. asked for each state's entire program, whereas the A.R.B.A. asked for inclusion of only such projects as could be handled within a five-year period. Hence the A.R.B.A. figures should be the lesser.

City and county work

A questionnaire survey of needed work by counties and municipalities made by the municipal and county divisions of the A.R.B.A. indicates that those agencies are planning work to cost well over $8,000,000,000. No details are available. The survey covered all cities over 10,000 population and all counties that normally carry on highway construction.

On the basis of the A.R.B.A. survey, the reservoir of state, city and local work totals $15,000,000,000.

Figures compiled by *Engineering News-Record* from reports of its correspondents, as given in Table I. Their total is much smaller than the A.R.B.A. total due to the fact that only specific projects are included, not over-all programs for which details have not been announced.

Work ready for contract

These are unofficial or semi-official records of available work. Official figures as to the amount of state highway work for which plans, specifications and estimates were ready by Dec. 1, 1943, as compiled by the Public Roads Administration are given in Table III. H. S. Fairbank, deputy commissioner, Public Roads Administration, in forwarding these figures states that it is believed that they represent a substantially correct picture of the situation with respect to federal-aid and state-primary construction as of Dec. 1. He calls attention to the fact that the problem of right-of-way acquisition reduces the volume ready for advertisement in 30 days to somewhat less than half the volume for which plans, specifications and estimates are now ready.

Comparable local data are not available, Mr. Fairbank states, but it is believed that an equal degree of readiness exists, particularly in view of the more prevalent use of force-account construction at that level.

According to reports to the PRA, plans, specifications and estimates for $353,700,000 of work on federal-aid state and secondary systems have been completed. By the first of June of this year $733,000,000 of work is expected to be ready for advertisement.

Employment created

Mr. MacDonald estimates that one third more men must be employed on highway work for a substantial period after the war than were employed before the war. For all categories of highway service in the postwar period, he states that "there is indicated an average annual need for employment of 372,055 man-years on highway construction and 460,501 man-years on highway maintenance. This would provide 1,743,000 man-years of job and industrial employment." The stand-by program would add 301,254 man-years of job employment and a total employment of 973,050 man-years, including industrial employment.

These figures show that if the employment created by the program of urgently needed work is added to that created by the stand-by program and by highway maintenance it will be possible to create 1,134,000 man-years of direct job work and 2,700,000 of industrial employment as the highway industries contribution to meeting unemployment after the war.

Obviously, the places where highway deficiencies are the greatest will not always coincide with the points of greatest unemployment. But generally, the two needs will be found to lie close together because the greatest deficiencies in the highway system are found in the densely populated regions, which is where most of the war industries are located and where most of the returning soldiers will go. If serious unemployment develops in the more rural areas, to which some war industries were shifted to tap a new labor source, it can be met more easily by other means. Many of the workers in those plants came from rural pursuits and can return to such work. That is not true of the urban areas.

Disagreement over apportionment

The program of the A.A.S.H.O. as represented by the legislation now in Congress has been criticized by highway leaders in the populous industrial states for its failure to give adequate recognition to these conditions. Last March, realizing that a big postwar federal-aid program was needed and that for lack of some better way of apportioning the money among the states to meet actual postwar needs the money might be apportioned according to the old federal-aid formula, representatives of the highway departments of ten of these states met and drafted a formula that would better meet the needs of the populous states than does the old formula. The old 1916 formula gave equal weight to population, area and post-road mileage; the proposed formula, called the Cox formula for the chairman of the meeting at which it was drafted, allocates the money on the basis of one half population, one quarter post-road mileage and one quarter gasoline consumption.

The Cox formula was not accepted by the executive committee of the A.A.S.H.O. when it came to draft the postwar highway bill. Instead the committee proposed to apportion the money one half on population, one

TABLE II—COMPILATION OF POSTWAR HIGHWAY WORK MADE BY THE AMERICAN ROAD BUILDERS ASSOCIATION. (SURVEY NOT COMPLETE)

State	Estimated cost of proposed postwar construction	Estimated cost of highway, bridge & grade separations with rights-of-way obtained ready for letting Jan. 1, 1945	Estimated cost of highway, bridge & grade separation projects without rights-of-way obtained otherwise ready for letting Jan. 1, 1945	Total with and without rights-of-way Jan. 1, 1945
Alabama	.....	.....	.....	.....
Arizona	64,000,000	18,000,000	9,000,000	27,000,000
Arkansas	100,000,000	.....	13,000,000	13,000,000
California	469,000,000	75,000,000	.....	75,000,000
Colorado	167,000,000	9,500,000	22,000,000	31,500,000
Connecticut	99,000,000	29,000,000	25,000,000	54,000,000
District of Columbia	.....	.....	.....	.....
Delaware	.....	.....	.....	.....
Florida	148,000,000	.....	.....	.....
Georgia	407,000,000	.....	.....	.....
Idaho	40,000,000	.....	10,000,000	10,000,000
Illinois	95,000,000	71,000,000	15,000,000	86,000,000
Indiana	161,000,000	.....	15,000,000	15,000,000
Iowa	.....	.....	.....	.....
Kansas	70,000,000	7,500,000	13,000,000	20,500,000
Kentucky	108,000,000	52,000,000	30,000,000	82,000,000
Louisiana	208,000,000	.....	6,000,000	6,000,000
Maine	15,000,000	.....	9,000,000	9,000,000
Maryland	45,000,000	15,000,000	9,000,000	24,000,000
Massachusetts	126,000,000	.....	14,000,000	14,000,000
Michigan	.....	.....	.....	.....
Minnesota	221,000,000	56,000,000	13,000,000	69,000,000
Mississippi	139,000,000	.....	.....	.....
Missouri	128,000,000	55,000,000	12,000,000	67,000,000
Montana	82,000,000	11,000,000	3,000,000	14,000,000
Nebraska	82,000,000	.....	22,000,000	22,000,000
Nevada	76,000,000	17,000,000	.....	17,000,000
New Hampshire	26,000,000	10,000,000	.....	10,000,000
New Jersey	134,000,000	10,000,000	8,000,000	18,000,000
New Mexico	155,000,000	.....	.....	.....
New York	550,000,000	.....	.....	.....
North Carolina	100,000,000	14,000,000	10,000,000	24,000,000
North Dakota	.....	6,000,000	6,000,000	12,000,000
Ohio	300,000,000	.....	41,000,000	41,000,000
Oklahoma	250,000,000	.....	.....	.....
Oregon	200,000,000	8,000,000	46,000,000	54,000,000
Pennsylvania	500,000,000	.....	.....	.....
Rhode Island	32,000,000	.....	6,000,000	6,000,000
South Carolina	171,000,000	25,000,000	.....	25,000,000
South Dakota	22,000,000	22,000,000	8,000,000	30,000,000
Tennessee	205,000,000	.....	.....	.....
Texas	542,000,000	392,000,000	11,000,000	403,000,000
Utah	.....	.....	.....	.....
Vermont	42,000,000	1,000,000	3,000,000	4,000,000
Virginia	125,000,000	5,000,000	6,000,000	11,000,000
Washington	65,000,000	48,000,000	12,000,000	60,000,000
West Virginia	163,000,000	.....	.....	.....
Wisconsin	69,000,000	.....	.....	.....
Wyoming	400,000,000	10,000,000	.....	10,000,000
	7,101,000,000	967,000,000	397,000,000	1,364,000,000

TABLE III—ESTIMATED COST OF POSTWAR CONSTRUCTION FOR WHICH PLANS, SPECIFICATIONS AND ESTIMATES WERE READY ON DEC. 1, 1943

Public Roads Administration summary for 48 states and District of Columbia

States Reporting			
31	(1) Total estimated cost of construction on state highways not on regular federal-aid or federal-aid secondary systems	$40,640,100	
47	(2) Total estimated cost of construction on state highways on regular federal-aid system	257,508,900	
38	(3) Total estimated cost of construction on state highways on federal-aid secondary system	38,834,300	
47	(4) Total estimated cost on state highway system (1+2+3)	.....	$336,983,300
14	(5) Total estimated cost of work on federal-aid secondary system not on state highway system	.....	16,675,000
47	(6) Total estimated cost of construction (4+5)	.....	353,658,300
43	(7) Total estimated cost of work that could be		
	(a) advertised in 30 days	167,585,700	
46	(b) " " 90 "	191,418,300	
49	(c) " " 6 months	373,966,000	
49	Total, Item 7	.....	$732,970,000

quarter on area and one quarter o post-road mileage.

This in turn was not acceptable t the protesting states. As a result o their protest, the executive committe put forward a proposal to increas the federal aid for postwar highway by $250,000,000 a year, allocating a the money on the basis of urban popu lation. If this change is made, th formula in HR 2426 would be altere to roughly 40 percent on the basis o total population, 20 percent on urba population, 20 percent area and 2 percent post-road mileage.

To emphasize the inequality even this modified formula, Willia J. Cox, state highway commissione of Connecticut, took the A.A.S.H.O tabulation of state highway needs an set it over against the federal fund that would be allocated to each sta under the modified formula. Th shows that nine states will get mo than $1 for each dollar of record need, Wyoming getting the most, nearly $2. On the other hand, 1 states will get less than 50 cents p dollar of road need, Texas, West Vi ginia, and Connecticut getting le than 25 cents. Mr. Cox's opposition t the formula is understandable becaus his state foots the list with only 1 cents for each dollar of need.

Agreement needed

The unfortunate part of this di agreement is that it leaves the sta representatives in a position of n being able to go before Congre united as to what should be done the way of legislation for postwa highways when Congress comes t consider the postwar highway bi Also, this disagreement gives weig to the conclusion of some highwa authorities that no formula will ad quately meet the postwar situatio Allocation must be based on actu deficiencies as determined by so central agency such as the Publi Roads Administration. The Roa Committee of the House has autho ity to have such a study made a much of the data on which to ba sound findings are available in th highway planning surveys made b the states during the past few yea

An early start possible

Up until quite recently all thi ing with respect to a resumption highway work has been on the ba that work would not be resumed u

the end of the war. Now it appears to be not improbable that an early end of the European phase of the war may release enough men, materials and equipment to permit a start on badly needed highway work long before the Pacific phase is ended. In fact, there is more than a remote possibility that some work could be undertaken even before the end of hostilities in Europe.

Bituminous material, cement, crushed stone, gravel and sand all are plentiful; steel for reinforcing concrete is less critical than it was a few months ago. Only manpower and construction equipment still are scarce.

The manpower situation appears due for a definite change before the year is out. Some war plants already have been shut down and the closing of others is in prospect. Even though other war industries still must be expanded, it is apparent that the peak of employment is near, if it has not already been passed. As soon as the peak is passed, resumption of peacetime activities will be necessary, and because highways are so essential to the national economy, it seems probable that highway work would be among the first to get the go-ahead signal. Certainly that will be the case in any areas where unemployment of considerable magnitude develops.

Lack of equipment

Inability to get the necessary construction equipment stands as a serious obstacle to an early start of highway building on any considerable scale. In fact, some highway engineers fear that the lack of sufficient construction equipment may make impossible an early start on a postwar highway building program at anything like the scale that is now proposed should the war end suddenly.

Nevertheless, the equipment situation is not entirely black. In the light of what already has happened in connection with the production of some other war materials it does not appear improbable that the peak demands for construction equipment and for other types of war equipment now being made by the manufacturers of construction equipment is close at hand, in which case some equipment for civil needs could be made available in the relatively near future.

Another factor that needs to be considered in attempting to appraise those that may affect an early start on a large highway program is the supply of experienced highway contractors. The possibility of there being an insufficient number of contractors ready to take on a highway building program of the magnitude now proposed was raised at the recent A.A.S.H.O. meeting by Charles H. Sells, superintendent, New York Department of Public Works. Mr. Sells believes that the ranks of highway contractors have been so widely scattered as to make it improbable that highway construction on a scale far larger than ever heretofore undertaken can be started quickly after the war. Like views were expressed by other highway engineers at the meeting, but some had no such fears.

Right now, shortage of staff in many state highway departments quite definitely is setting back the date at which those departments can start work on a large scale. Some departments have relatively little work ready for an immediate start. This has been due in part to concentration on the construction of access roads to military establishments and war plants. Though that program now is about complete, those departments could not make a quick start on a large program for many months to come without calling in outside help.

FINANCING THE PROGRAM

Financing a program as large as either of those now proposed may be a factor that will delay or prohibit an early start in some states. The possibility that some states would not be able to match an abnormally large offering of federal funds for postwar highway work, presumably, is one reason why the American Association of State Highway Officials, in drafting the postwar legislation now in Congress, reduced the matching of federal aid from dollar for dollar to one state dollar for each three federal dollars. On the normal 50-50 matching basis, it would be very difficult for some states to take up their share of the one billion dollar a year program laid down by the association; and of course any such matching under the three billion dollar a year program put forward by the American Road Builders Association would be still farther out of the question.

There appears to be ample evidence that at least one billion dollars worth of work will be ready for advertising before the end of this year. This would provide for a program closely approaching that of the American Association of State Highway Officials, but would be far short of that considered by the American Road Builders Association to be essential to our national economy. However, this does not mean that highway building at an annual rate approaching that visualized by the A.R.B.A. is not attainable. It appears to indicate rather that the higher annual rate can only be attained over a period of many months. Highway department staffs to plan and direct the work, and contracting organizations with men and equipment to do the construction, cannot be organized and equipped overnight.

But before any program can be put under way there must be agreement on legislation to provide the federal share of the cost.

If the most urgent highway needs are to be met promptly regardless of where they may be concentrated, and if the maximum amount of employment is to be provided should serious unemployment develop, it is necessary to recognize that the proposed highway program is an abnormal one, not one to be financed as federal-aid highway work has been financed during normal years in the past. Assuming that the program is to be divided into two parts as recommended by Thomas H. MacDonald, federal funds could be apportioned to the states on a 50-50 matching basis for such work as the Public Roads Administration shall determine to be the most urgent. No attempt should be made to apportion this money among the states by formula.

Funds for the stand-by program might be apportioned to the states on a 75 percent federal-25 percent state basis on the assumption that the national interest is paramount in a program designed primarily to check the spread of unemployment. But here again, apportionment among the states should be on the basis of unemployment, not by formula.

Obviously, apportionment of federal funds for highway work in this

manner should not be continued beyond the immediate period of postwar readjustment. Ultimately, apportionment must be returned to a formula basis or to some plan based on clearly defined method of determining the highway needs of each state or region. In the long run, the populous industrial states must bear part of the cost of building highways across the sparsely settled regions of the country.

Finally, all this planning will be wishful thinking if adequate state and federal financing is not arranged well in advance. Herein is the chief reason why early agreement on a federal program is so essential. The states should know what is to be required of them while their legislatures are still in session. States with more federal money offered to them than they can take up cannot put all of their part of the program under contract. Also, states with more money offered to them than is required to make up serious deficiencies in their system will not be likely to take it up quickly even on a 75-25 matching basis, except in case of serious unemployment. Both of these conditions will check the rate at which the program gets under way. This is why programming for the postwar period must be on the basis of need and of ability to use the federal aid, not on the basis of equitable apportionment of funds among the states regardless of needs.

Programming that disregards any of these basic facts will be far from realistic.

* * *

Concrete evidence of the fact that some state highway departments are getting a large amount of work in shape for contract letting will be found in the four following articles in this special section on Planning for Postwar Highways.

Planning Well Advanced in California

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***Contents in Brief**—With an early start that secured a $12,000,000 legislative appropriation last August for postwar project design, followed by a program that arranged for the existing organization to take over surveys, plans, specifications and right-of-way purchases, California could start any time on some projects and by June 1 will have on the "ready" list jobs estimated to cost a total of $33,000,000.*

PLANNING FOR FUTURE HIGHWAY construction in California is already well under way. Postwar highway projects whose total cost will be about $80,000,000 have been approved by the highway commission for the detailed studies, plans, specifications and purchase of right-of-way that will bring these projects to the point where calls for bids can be issued. As of Jan. 1, 1944, about 10 percent of this total list (about $8,000,000 worth) was ready to advertise. By March 1 it was expected that $11,000,000 more would be ready and by June 1 another $14,000,000, thus making the total by June 1, 1944, $33,000,000 worth of work ready to relieve unemployment and to help in the period of readjustment that is expected to follow the war. More time will produce more plans.

This advanced stage of postwar planning was not brought about without an outlay of considerable time and effort. In fact, this progress has been possible only because of advance realization of what could be expected to happen. Foresight in state highway planning, notably that of C. H. Purcell, director of public works, laid the groundwork for progress in this direction more than a year ago.

It was foreseen that reduced revenue would result from the lessened gas tax collections. (In California 1½ cents out of the 3-cents-per-gallon tax on gasoline is allotted to maintenance and construction of state highways.) It was apparent that with decreased income and restrictions on use of materials there would be very little construction (and most of that on access roads); that, except for necessary maintenance, a great deal of the usual highway activity would be deferred and improvements would have to accumulate for later attention. It was in planning for this accumulation that groundwork was laid for what is now known as the postwar program.

To secure funds for work of this classification, early in 1943 the legislature was asked to appropriate $12,000,000 for surveys, plans, specifications and rights-of-way for postwar highway projects. It was pointed out that this work would help relieve unemployment and would greatly reduce the mounting maintenance costs by replacing worn-out, overloaded and inadequate facilities with adequate construction.

The legislature did appropriate this amount and the only proviso with it was that the highway commission is to make a report to the legislature showing just what uses have been made of these funds.

In addition to this appropriation there are other funds. The estimated funds available for the biennium from state highway revenues is $6,000,000 for right-of-way purchases and $4,000,000 for engineering. There is also as much as $2,000,000 in federal aid available for survey and plan work if the state is able to apply this amount cooperatively on projects eligible for federal aid.

Division of Highways also has certain responsibilities in cities and counties. The legislature at its 1943 session appropriated $1,500,000 for surveys and planning on county roads with the proviso that this money must be administered by the division. This money was allotted on the basis of $5,000 to each of the 58 counties and the sum remaining is to be distributed

among the counties on the basis of motor vehicle registration. The division is not required to make these surveys and designs; in fact, it has asked the counties to do their own engineering work and has suggested that the state can undertake survey and design work for counties only after the state work has been completed. Approval of the county-selected program of projects, however, is required from the Division of Highways.

Funds for work in the cities

Within cities there is still another source of funds that will help out in the postwar highway program. This is the ¼ cent per gallon of gas tax money that goes to the cities for use on state highways within the city limits. Since this money cannot be used for construction during wartime, the state has suggested that cities make use of it for surveys, plans and the purchase of rights-of-way on postwar projects. A number of cities have already accepted this suggestion. The money that cities will receive during the current biennium from this source is estimated to total about $5½ million.

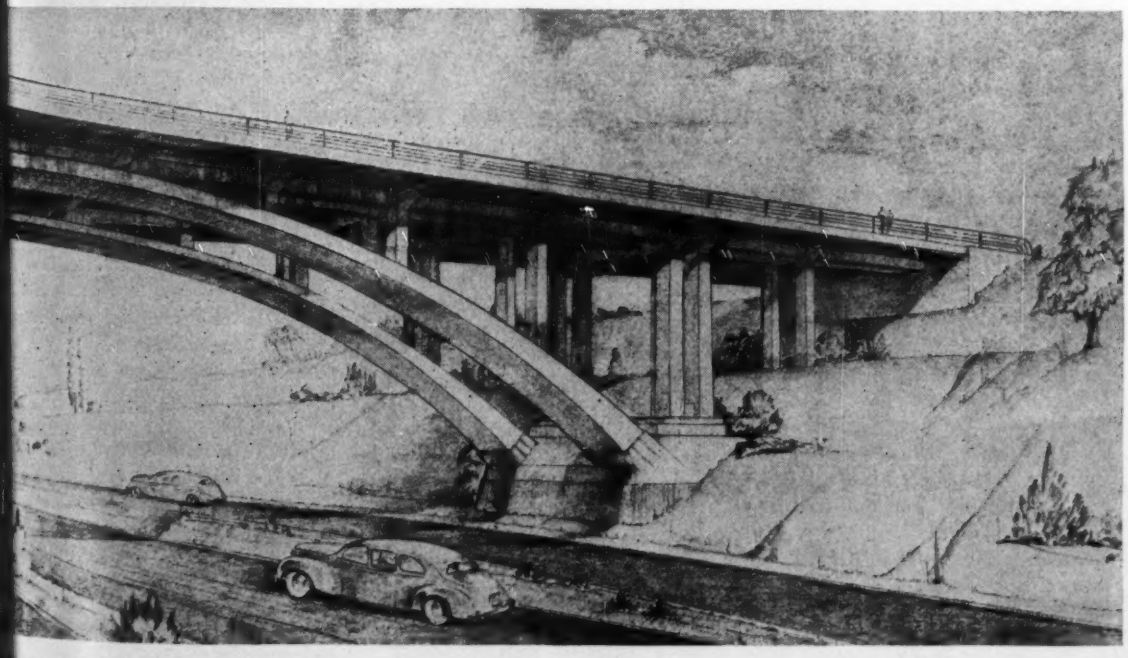
Since Pearl Harbor, the Division of Highways has lost about 30 percent of its engineering personnel, mostly to the armed forces. (Because most of these were young men in relatively lower salary brackets, the proportionate reduction in outlay on salaries has not been nearly so much as 30 percent.) During 1943 the reduced personnel has completed plans and supervised construction on access road projects, flight strips, etc. that have a total value of about $23,000,000 and is now finishing up additional work that will total about $5,000,000 more. (This is an increase of about 40 percent over the volume of work ordinarily done in a 12-mo. period.) As this work is completed and the personnel can be released for other assignments, all workers are transferred to postwar planning activity. Also, a considerable number of women are being employed. At present about 5 percent of the total number of employees in the engineering division are women. These include field as well as office workers.

Personnel engaged in postwar planning are distributed throughout all of the eleven district offices where they are made part of the regular organization working under the district engineer. All surveys and plans for new roads and structures are reviewed by Sacramento headquarters. All bridge design is under the bridge department which is in the Sacramento office. The Division of Highways is now authorized to appoint persons for temporary service without requirement of a regular civil service examination. These appointments are for a year and for the duration but not longer than 90 days after the end of the year.

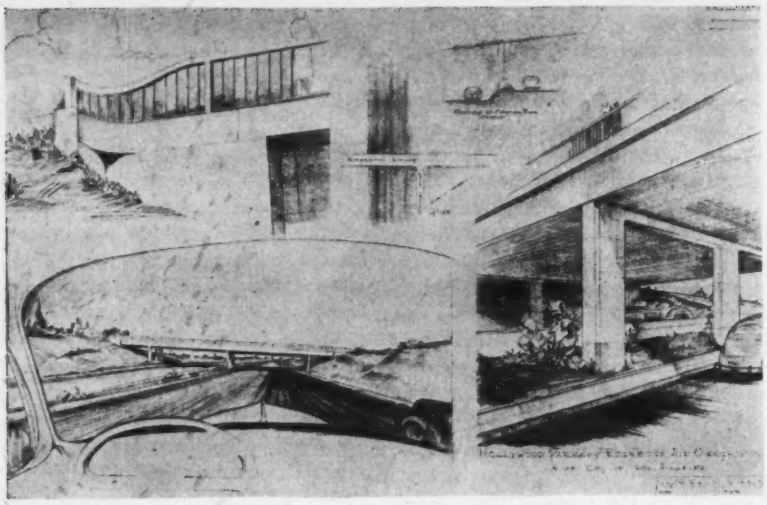
Character of postwar projects

The accumulated construction work deferred by reason of wartime restrictions on labor and critical materials meant that quite a few projects were under investigation prior to organization for postwar planning. In fact, work on surveys, designs, specifications and right-of-way purchases on some $6,000,000 worth of such work, in the list of what are now postwar projects, had been completed before postwar organizations began to function. Prior to the first of the year another $8,000,000 had been advanced into the stage of 75 to 90 percent complete.

Most of the postwar projects fall into three general classifications. The first is the regular run of road construction jobs that had been previously contemplated and heretofore included in the budget but deferred for one reason or another principally because of war restrictions. Included in this class also are the construction jobs that would have been part of the current biennium program if war had not intervened. A considerable part of this work is construction and reconstruction of surfaces, paving, widen-



Landscaping, which has been slighted for the duration, is reappearing in postwar plans. Here shown is the terracing at the structure that will carry Hill Street over the Hollywood Boulevard in the Los Angeles region.



Typical artist's drawing, such as now are added to engineering drawings, to help visualize the finished appearance of a proposed structure.

ing and expanding of roadways to four lanes or more.

The second classification comprises bridges and structures, principally those that have reached a stage where they can no longer carry legal loads. Such structures have been posted for restricted loads and are being kept in service by special care in maintenance operations. There is perhaps a total of $30,000,000 worth of work in this classification which must ultimately be accomplished in California; about 20 percent might be said to be of an emergency nature.

The third classification, which comprises about 50 percent in dollar value of the total cost of work, is freeways and major arteries into and through populated centers. On some of these projects 75 percent of the right-of-way has already been acquired looking to early construction.

Acquisition of right-of-way

Acquisition of rights-of-way for freeways is a tedious job, particularly in the cities. Here the holdings are small and a large number of owners must be contacted. The cost of the rights-of-way on some such projects amounts to more than the cost of construction. Moreover, since right-of-way procurement cannot start until a certain part of the design has been completed, right-of-way must be pressed in order to complete the job on time. These matters are handled by the right-of-way agents in each district office. In the cities where property values are high the policy is to buy no more width than adequate to include all of the improvement. Outside the urban areas the right-of-way secured is up to 250 or 300 ft. wide.

Changes in design practices

In grade separation, which is receiving careful attention on the freeways, there is a tendency away from the cloverleaf type of structure in favor of the more direct route design better suited to intersections where traffic interchange is large. The cloverleaf is not used in built-up urban areas because of its lower capacity as well as because of the added travel distance and greater difficulty of operation. Three- and four-level interchange structures may be employed at important intersections.

In the design of concrete pavements the tendency is away from reinforcing except at joints where steel dowels or adequate load transfer devices are used to insure continuity of surface alignment across the joint. On important travel arteries, particularly freeways, all lanes will be 12 ft. wide. Adequate base support and compacted subgrades are features of road design receiving their full share of attention. Otherwise, there has been little notable change in pavement design.

The practice of making artist's sketches and models to supplement engineering drawings has come to the fore in connection with postwar planning. Where rather complex structures are involved, it helps greatly in "selling" the idea to the public to have a perspective scale drawing, or a model, that conveys a definite idea of just how the finished structure will look.

Greater and more ample clearances are being introduced in structure design.

Some new roads on the list of projects investigated lend themselves admirably to the interregional highway idea. Typical portions of these are the proposed route leading into, through and out of the Los Angeles metropolitan area. Here a main route, leading from one population center or region to another, passing through a highly improved and congested area would afford an almost ideal example of an improvement on which there would be a minimum of restrictions or interruptions of any kind.

With respect to the possible enlargement of engineering staff required to construct these postwar projects, this will depend upon the rate at which the program is to be undertaken. The average construction program on the California state highway system in recent normal years has been about $20,000,000 per annum. There have been some estimates of revenue for postwar projects as high as $56,000,000 per year for 3 years. If any such rate of construction were undertaken, of course the normal size of the state highway forces would have to be greatly augmented.

A flexible program

A logical program might be to suit postwar construction activity to the unemployment situation. The postwar program has been laid out with a view to flexibility so that it can be expanded or restricted in accordance with the manpower situation. In this connection it should be noted that the state is now required to do more maintenance work than ever before because of (a) the damage to or destruction of road surfaces by exceptionally heavy wartime traffic and (b) the deferment of reconstruction work which ordinarily would have been done at a much earlier stage of pavement deterioration. In other words, postponed reconstruction has greatly increased maintenance costs.

This situation emphasizes the importance of a comprehensive program of postwar construction—one to meet the urgent needs that have developed on the state highway system. Such a program would provide the improvement necessary to rehabilitate the highway transportation system so that it can contribute its share to the economic welfare of the state and nation.

Louisiana's Postwar Program Emphasizes Traffic Relief in Urban Areas

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Contents in Brief *— Highways to relieve congestion around the large towns and cities stand first on Louisiana's postwar program. Work totaling $208,000,000 is on the books, which is more than enough to take up the funds that are now expected to be made available to the state after the war. Much work remains to be done on plans, specifications and estimates. Design standards are being improved over those in use before the war.*

AT THIS STAGE of our postwar program, while the overall program is assuming a less nebulous shape, the various items or projects that will eventually comprise the program cannot be separately defined except for some project plans that have been carried over from prewar programs and a few project plans for rural highways that have been completed since the war began. The most definite description of a proposed postwar works program must consist merely of brackets or classes of possible construction or rehabilitation activities. Our ideas in the preparation of our postwar program have been adopted from or conform to the trend of thought that has developed out of the experience and research activities of the Public Roads Administration and associated agencies.

Relief of traffic congestion in urban areas is receiving especial emphasis in the development of the postwar highway program for Louisiana. Although there are many miles of rural highways that remain to be improved, there are few rural areas in Louisiana that are unreasonably remote from some type of hardsurfaced highway. Thus the rural highway system, except for its increasingly needed rehabilitation, is reasonably adequate. By contrast, the tremendous increase in the number of motor vehicles, as well as the increase in mileage traveled per vehicle, encouraged by the hardsurfacing of rural highways, has created a congested condition in cities and large towns so that the locus of present-day traffic problems is almost exactly opposite from what it was in 1916 when the first federal highway act was passed. Hence postwar planning must be centered on bettering traffic conditions in and around our large towns and cities.

Employment also considered

Our postwar plan is not directed solely toward making up the deficiencies in our highway system, and important as that is, scarcely less important will be the problem of relief of postwar unemployment. Before the end of the war there will be over 200,000 citizens of Louisiana in the armed forces. It is estimated that an additional 100,000 citizens are now engaged in some activity directly connected with and supported by military operations. It now seems clear that a large number of these people, when military operations and munitions manufacture terminate, will not find waiting a ready means of livelihood unless such a means is planned in advance.

Fortunately, those areas where the improvement of highways is most urgent are those areas where the concentration of unemployment will exist. Thus means for the relief of unemployment by the construction of highway and street improvements will exist co-extensively with pools of unemployed available to undertake such construction.

The Louisiana postwar highway program at the opening of the year 1944 totalled approximately $208,000,000 of which $135,825,000 is classified as road construction and $72,175,000 as bridge and grade separation construction. The principal brackets or groups of the program, which cannot at this time be broken down into individual projects, are shown in the accompanying table. Of this total, $5,900,000 represent project plans that had passed the P. S. & E. stage (Plans, Specifications and Estimates) before this country entered into the war. The construction of these projects was, of course, suspended for the duration of the war. Perhaps this was fortunate because, since the beginning of the war, higher design standards have been developed and adopted and the period of construction inactivity has, therefore, provided the necessary time for a revision of the plans to comply with the higher standards adopted.

To a considerable extent these revisions have been accomplished and at the present time projects estimated to cost $1,700,000 could be placed under construction. An additional group having an estimated cost of $2,600,000 could be placed under contract as soon as rights-of-way have been acquired. These projects, having a total estimated cost of $4,300,000 represent 2.4 miles of urban four-lane express highways, 17.8 miles of rural two-lane highways and stage construction of 19.3 miles of four-lane rural highways.

With our present staff and the funds that are now available without further federal legislation, we should be ready to let contracts for an additional volume of work estimated to cost $7,000,000 by January, 1945.

The total volume of work which could be placed under contract by Jan. 1, 1945, therefore, is $11,400,000, which is less than 50 percent of the amount that would be available for

highway construction in Louisiana should the legislation proposed in H. R. 2426 be enacted. Obviously, if Jan. 1, 1945 is to be considered as a deadline, the work of preparing plans must be very materially accelerated and all efforts are now being made to expedite the preparation of plans. Our principal concern is for the plans that must be available when the war terminates. No difficulty in completing plans for the second and third postwar years is anticipated.

Acquisition of right-of-way

Much of the right-of-way for the projects that are ready for contracts or approaching the contract stage was acquired before the war. Rights-of-way for other projects that are well advanced in the planning stage are being acquired but none is being purchased for projects that must be financed under the postwar highway legislation now before Congress and none can be acquired until some means is provided for the subsequent participation in the cost of the right-of-way by the federal government. This is a problem that needs urgent attention at the present time.

Under Public Act No. 295 of the 77th Congress, apportioning money among the states for the preparation of complete plans and contract documents, Louisiana received an allotment of $147,961 and under Public Act 146 of the 78th Congress, the funds for like studies made available to Louisiana amounted to $756,893. As both allotments have to be matched equally with state funds, the total that can be made available for advancing projects to the contract stage without further legislation is $1,809,708. Approximately only $13,000 of this has been spent on surveys, preparation of plans and contract documents up to Jan. 1, 1944, but it is expected that this expenditure will amount to more than $400,000 before January, 1945.

Financing this work

Louisiana's share of the unexpended federal-aid funds that were made available to the states until one year after the end of the war by Congress last July amounted to $8,236,890 at the end of 1943. This money must be matched on a 50-50 basis. Louisiana's share of the $1,000,000,000 per year for the first three years following the war that is called for under the legislation now before Congress would be $15,804,600 per year, under the apportionment formula originally written into the bill. If the matching of $1 of state funds for each $3 of federal funds now in the bill is not changed before passage of the act, the amount of state and federal funds that could be expended in Louisiana annually will be $21,072,800 for each of the three years or a total of $63,218,400.

The amount of state funds required to match the federal funds will be $15,804,000. Presently available to provide these funds is an authorization of the legislature and an amendment to the constitution providing for a bond issue of $10,000,000, there is also available from previous authorizations and constitutional amendments unissued bonds in the amount of $1,400,000. Hence without further action by the state legislature, Louisiana would not be able to take up the entire amount of federal funds that would become available to the state in the third year following the end of the war.

In the meantime, no reserve fund is being accumulated from current revenues by the Department of Highways because current operation and maintenance expenses and debt service absorb all available current funds.

Prewar Comparisons

In the five years before the war Louisiana spent an average of $10,600,000 on new construction annually. Set over against the projected expenditure of $21,000,000 in each of the three years after the war, the Department of Highways must look forward to about 100 percent expansion of its construction program.

Because of deficiency of funds and wartime restrictions both on personnel and the procurement of materials and because of extraordinary wear and tear on highway surfaces caused by an increase both in the volume and weight of traffic, it is not possible to make an accurate estimate of the amount of deferred maintenance. It is large now, however, and it will rise sharply with each added year of the war.

Larger staff required

Supervision of the postwar construction program and the large volume of deferred maintenance and rehabilitation that must be carried forward simultaneously after the war will require a personnel expansion. The normal organization complement of the department is about 2,900, although the actual employed personnel

TABLE I—SUMMARY OF PROJECTS IN THE LOUISIANA POSTWAR HIGHWAY PROGRAM

A. Betterments. (New Construction and Improvements)	
1. Buildings, headquarters and district offices and shops	$1,000,000
2. Urban Projects, freeways and limited access design	100,000,000
3. Bypass projects limited access design	5,000,000
4. Rural projects	
a. Two Lane hardsurfaced highways	25,000,000
b. Two additional lanes to existing two-lane hardsurfaced highways	35,000,000
c. Two lane hardsurfaced highways for medium traffic	10,000,000
Total	$176,000,000
B. Replacements. (Reconstruction and major repairs)	
1. a. Retreading and sealing two lane medium traffic highways	3,000,000
b. Reconstructing two lane medium traffic highways	10,000,000
2. Metal Surfaces (gravel and shell). Two lane light traffic highways	6,000,000
3. Timber Bridges	
a. Reconstructing 200,000 lin. ft.	10,000,000
b. Repairing 400,000 lin. ft	4,000,000
Total	$33,000,000
C Equipment. Automotive and other mobile units	1,000,000
Grand Total	$210,000,000

TABLE II—MAJOR BRIDGES BEING CONSIDERED UNDER THE POSTWAR HIGHWAY PROGRAM

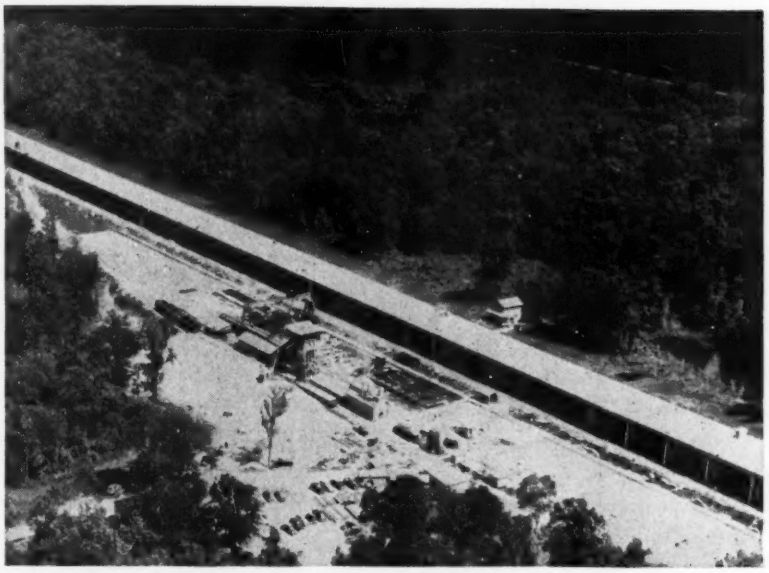
Location	Stream	Estimated Cost
New Orleans	Mississippi River	$10,000,000
New Orleans	Industrial Canal	1,500,000
New Orleans	Intracoastal Canal	1,500,000
Shreveport	Red River	2,000,000
Lake Charles	Calcasieu River	4,000,000
Alexandria	Red River	2,000,000
Monroe	Ouachita River	800,000
Plaquemine	Intracoastal Canal	400,000

less than 2,600. The turn-over of maintenance crews at the present time over 100 percent. It is now anticipated that immediately upon resumption of normal construction and maintenance operations, the department will require an additional personnel of at least 1,000.

Design standards raised

Since the beginning of the war the standards of design for highways have been raised most liberally. It is doubtful if the war was the cause of this improvement in design standards and it is believed that the publication of these high standards is merely a coincidence. The research and studies that form the basis for the improved standards have been going on for years, but it is only in the past year or so that the volumes on design policies have been published. In the design of projects for the postwar program, it is planned to adopt and use the latest and best standards that are available and the Department of Highways has prepared and promulgated for ready reference a schedule of the major elements of design standards to be used in the making of surveys and preparation of plans. Most of these new standards relate to geometric design rather than structural design.

In addition to the adoption of the 12-ft. traffic lane and turning radii sufficiently liberal to accommodate the largest legal articulated vehicles, the principal improvement in Louisiana is considered to be the abandonment of the method of securing earth for highway embankments within the limits of the right-of-way. In future embankment material not obtained from cuts will be secured from pits located not closer than 300 ft. from the right-of-way line, and the drainage of the highway will be obtained by higher grade lines rather than by the system of side ditches. All drainage will be carried across the highway right-of-way at the point of incidence. The section for concrete pavement will be 9-6-9-in. as before the war and will remain at those dimensions unless and until data developed by the Public Roads Administration research projects indicate that the section is too light. The policy on reinforcing concrete pavement will continue to conform to PRA ideas as to the needs for reinforcement. Our tendency is to increase the distance between expansion joints beyond the present 120-ft. maximum required by the Public Roads Administration and to employ expansion joint filler that will substantially resist expansion. Contraction joint spacing will remain at 20 ft. Depressed median strips for multi-lane highways are preferred, and a minimum width of 30 ft. for median strip for multi-lane highways has been adopted. Grades for the separate roadway surfaces of multi-lane highways may conform separately to the topography.



Louisiana recently completed this structure to carry U. S. 190 across the Morganza Floodway. A concrete roadway 50 ft. wide is supported on concrete bents formed of reinforced-concrete piles having an average length of 85 ft. The structure is three and one half miles long and cost about $4,000,000.

Freeway statutes and policy

Louisiana adopted a freeway law in 1940 but no projects have been constructed nor has any right-of-way been acquired for freeways. Although it is certain that freeway construction will be liberally employed in the postwar program, no formula appears to have been developed by which it is possible to determine what sections of highway should now be dedicated as freeways or limited-access highways. We would be reluctant to attempt to anticipate traffic over too long a period in the future and the best rule of thumb that occurs to us at the present time is that we will dedicate those sections of highway as freeways or limited-access highways for the distance that present-day urban traffic exists or exerts influences.

Practically, this means we will construct freeways or limited-access highways within the well defined urban areas and acquire right-of-way to assure the construction of freeways or limited-access highways for a distance beyond the well defined urban areas that will probably be affected by urban traffic.

Probable major bridges

Although at this time it is not possible to definitely determine either the need or the location for major bridge structures, and still less possible to give any accurate idea of the cost of such structures, the accompanying list is offered as an approximate idea of what may be needed.

The present Louisiana statutes authorize and permit the Department of Highways to assume and exercise control, both over the improvement and the maintenance of all rural highways within the state. There has been a very limited construction of rural secondary roads by the several parishes although the parishes still maintain a very substantial mileage of secondary and farm to market roads. Under the provisions of H. R. 2426, therefore, no difficulty or friction is anticipated in the administration of funds for the construction or rehabilitation of rural roads.

The department also can assume jurisdiction of parts of the state system within the city limits if necessary, but here again, full cooperation is anticipated.

Reconstruction of Existing Roads Will Dominate New York's Program

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***Contents in Brief**—New York's main task in the postwar period will be reconstruction of existing highways to improve their alignment, grades and width. New work will be limited to extensions of the state's parkway systems and construction of a system of "thruways". An ample amount of work is ready for contract and funds in sufficient amount to start a very large program are available.*

NEW YORK'S POSTWAR HIGHWAY program will be primarily one of getting caught up on deferred work that is badly needed. It is not to be a road-building program just to make jobs. With the exception of the proposed "thruways" and some additions to the parkways, the whole program will be reconstruction of existing sections of the state highway system. There will be very little new construction on the 1,354 miles of unimproved road that are part of the state system but upon which no work has as yet been done by the state highway departments. This is due to the fact that work is now so far behind on reconstruction of our heavily traveled highways that such work must get precedence over the unimproved parts of the system which generally are unimproved because of their small traffic volume.

The term reconstruction is used broadly in describing this work. An old road that is crooked, has bad grades or is restricted by encroachments of one kind or another may be relocated on a new right-of-way some distance from the old one. Even if the old road is abandoned as part of the state system, the relocated section still is considered as being reconstruction rather than new construction so long as no new mileage is added to the state system.

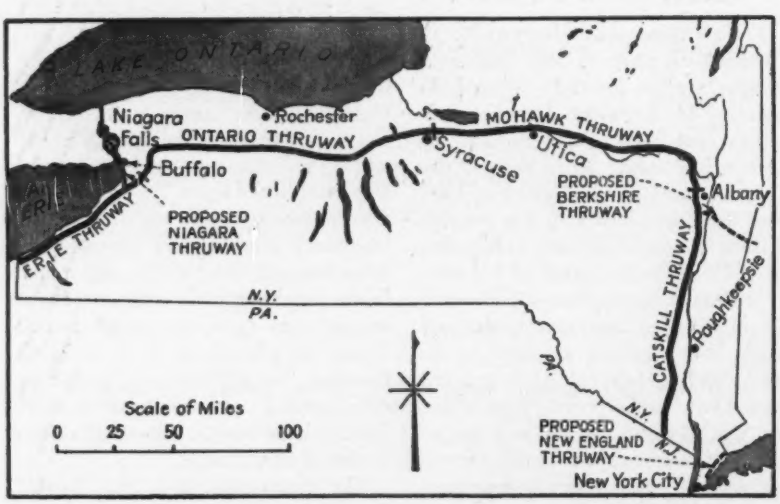

Fig. 1. Construction of a system of thruways up the Hudson and Mohawk River valleys and west to the Pennsylvania boundary was authorized in 1942. A start on this work is included in the postwar plans.

Highway failures that have made this extensive reconstruction necessary have not been pavement failures to any considerable degree; the failures have been those of width, alignment, grade or sight distance, deficiencies that come with age and progress in highway development.

Similarly, the bridge reconstruction work is replacement of over-age and outmoded structures. This work must be stepped up under the postwar program due to the fact that a large number of bridges were built by the towns in the horse-and-buggy days and are now at the age when replacement is necessary.

Thruways proposed

Some of the new work to be done under the postwar program will be on thruways and parkways. In 1942 the legislature added to the state highway map a system of thruways totaling 482 miles. The purpose in thus adding to the system was to provide high-speed thoroughfares located outside the centers of population, yet serving areas in which 80 percent of the population of the state lives. Subsequently, funds were made available for the preparation of plans. This year the legislature will be requested to appropriate funds to permit a start on the actual construction of these thruways as soon as possible after the war.

Rough estimates put the cost of these thruways at $200,000,000. They ought to be built as quickly as possible because of the traffic relief they will provide in many regions, but it is realized that at best about five years will be required for their design and construction. In the first year following the war about $20,000,000 of work is expected to get under way, but by the third year the total per year should reach $60,000,000. The actual program depends on the size and timing of appropriations yet to be made.

Work will be started first on the sections that promise the greatest aid in relief of traffic congestion. These are the Erie and Ontario thruways and the middle section of the Catskill thruway.

Thruway design details

These thruways are to be four-lane or six-lane controlled-access highways built on a right-of-way of 200 ft. minimum width. Mall widths will vary, the layout being made flexible so that full advantage can be taken of the possibilities for fitting the traffic lanes to the topography with a minimum of change in the landscape. The right-of-way is not to be treated as a parkway, but an effort will be made to avoid monotony without sacrifice of safety or driving ease. The present design thinking is directed toward providing for speeds of 70 mph. Minimum sight distances will be 1,000 ft., minimum curve radius, 2,800 ft., and maximum grade, 3 percent generally.

Traffic lane widths are to be 12 ft. There will be acceleration and deceleration lanes at all entrances and exits. Under the law establishing the thruways, access can be controlled. It is hoped to limit access points to intervals of not less than three miles without too much inconvenience to the public, but of course this long spacing will not be practical where the thruways cross settled areas, as they must despite efforts to locate them in the less densely populated region. In these areas it will be necessary to build parallel service roads at some points to reduce the points of entry and departure from the thruway

Parkways

Parkways make up another part of the new construction in the postwar program. Unlike the thruway, however, they represent largely deferred work. Work now projected on Northern State Parkway and Southern State Parkway in Long Island, on the final extension of Taconic State Parkway and on the proposed Palisades Interstate Parkway, totaling $37,000,000 is in prospect, but all money to complete the plans and specifications is not yet available. Only about $23,000,000 of parkway work could be put under contract within two years after the war. If the legislature provides money for further work on plans and specifications, the remainder of this parkway work will be ready for contract by 1947.

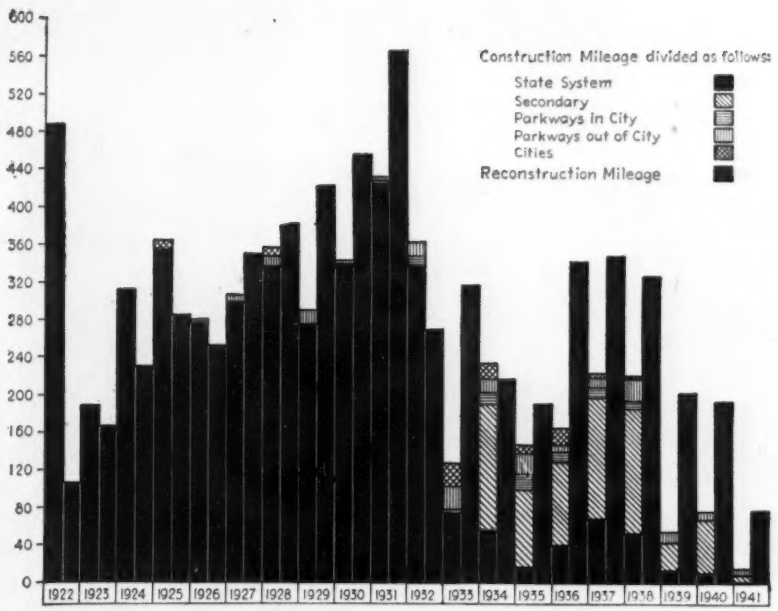

Fig. 2. Changes in the character of highway work in New York State are clearly shown in this chart, prepared as part of a study made by H. C. Schermerhorn, commissioner of highways. In the 10 years from 1922 to 1932, construction and reconstruction on the state system dominated; since 1932, new construction has been concentrated largely on parkways and the secondary system, with reconstruction continuing at a fairly high rate.

Grade crossing elimination forms another portion of the proposed postwar program. About $41,000,000 of the $300,000,000 for which bonds were authorized in 1925 for the elimination of railroad grade crossings remains for postwar work. Plans for 21 projects totaling $10,000,000 have been completed and plans for 35 projects to take up the greater part of the remainder are under way. At least $5,600,000 of grade crossing work could be included in the first year's postwar program.

If federal funds are made available for postwar grade crossing work, nearly $5,000,000 in the reconstruction of antiquated crossing elimination structures could be added to the first year's work. Nearly $10,500,000 more could be added at a later date.

Maintenance operations will not have to be stepped up materially as part of the postwar undertaking. Maintenance work has been continued at a reasonable rate during the war years, hence there has been no serious accumulation of work other than that which is due to the fact that for years there has been insufficient appropriations to maintain roads in the condition in which they should be maintained for best efficiency.

However, the condition of maintenance equipment is serious and may give a serious aspect to the whole problem of maintenance if something is not done about it soon. Shop facilities also are at low ebb. Much more in the way of equipment and repair parts than is now in prospect is required if this condition is not to become critical before the end of 1944.

Extent of the program

The extent of the postwar program will depend on legislative appropriation. If all the money that is taken out of the taxpayer's pocket in gasoline taxes and motor vehicle fees were devoted to highway improvement, the only limit to what could be done in the postwar years would be the physical limit on what work could be put under contract in any year efficiently. But the motor vehicle taxes go into the general fund and the amount that goes into road work in any year depends on what the legislature appropriates for such purposes.

We now have roughly $23,000,000 representing money appropriated in this way in past years and about $60,000,000 in accumulated balances of various bond issues that have not been used for construction due to war restrictions. This is available to match federal funds as soon as they are

Fig. 3. Extension of the state's system of parkways will make up a considerable part of the postwar program. Here shown is Eastern State Parkway south of Poughkeepsie. Median widths are varied to suit the topography.

authorized. The legislature now in session will be requested to provide additional funds for this program.

At the end of 1943 there was between $240,000,000 and $250,000,000 of deferred work on highway reconstruction, parkways and grade crossing elimination, much of which can be let to contract quickly. Add to this $20,000,000 of work on thruways in the year following the end of the war and $5,000,000 of grade-crossing reconstruction in the same year, if federal funds are appropriated for that work, and it will be seen that New York will have at least $275,000,000 of work on the state highway system that could be put under way as fast as practical after the war. If the federal government includes funds for secondary roads in the proposed postwar highway act, the amount allocated to New York state can be added.

In the past when the federal government appropriated funds for farm-to-market roads the Division of Highways designed and built those roads and turned them over to the counties under a maintenance agreement. Presumably the same procedure will be followed this time.

Stepping up our program

In the 20 years 1922-1941 New York State averaged an annual expenditure of $22,531,600 for construction and reconstruction of highways, exclusive of grade crossings and bridges. The highest year in that period, 1931, was more than double the average, being just short of $47,000,000.

New York's share of the $1,000,000,000 a year for three years following the war proposed in the bill now before Congress will be about $62,000,000 per year for federal-aid highways. If matched on the ratio of one state dollar to each three federal dollars, as now called for in the legislation in Congress, the total annual federal-aid program for the state highway system exclusive of urban streets and secondary roads, would be roughly $41,000,000. If the normal 50-50 federal aid matching is included in the proposed federal act instead of the 25-75 matching in the bill as now drafted, that would raise the total federal-aid program for New York State to $125,000,000 a year for three years. And if the formula for allocating the federal money to the state is modified to give a larger share to the more densely populated states, the potential New York program would be that much larger.

Contractors share in program

These figures show roughly what New York *could* undertake in the way of postwar highway work. How much actually will be put under way in the first year after the war depends on many factors, the chief of which are the availability of contractors to do the work and the supply of equipment and materials needed for such a large program. The war has decimated the ranks of highway contractors and most of their equipment has gone into war work. These ranks cannot be built up quickly. Whether or not equipment can be obtained quickly depends on how much equipment is in the country at the end of the war, on how much the manufacturers can produce on short notice and how quickly it can be placed in the hands of the contractors.

In so far as financing and plans are concerned, New York stands ready to undertake all the work that could be put under way in each of the three years following the war. How much actually will be put under way depends on the contractors' ability to absorb work, a problem that needs careful study as part of the planning for postwar highway construction.

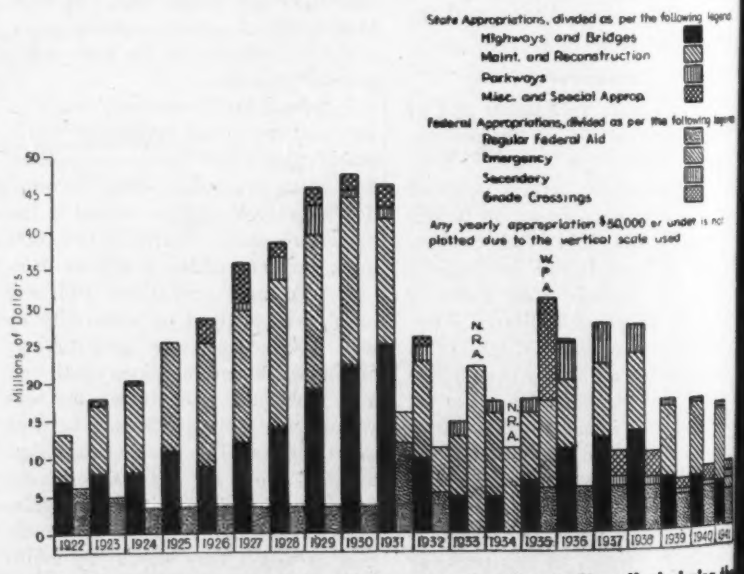

Fig. 4. State expenditures for new highway construction in New York during the past 20 years far exceeded appropriation except for two years.

Illinois Speeds Roadbuilding Program

Wesley W. Polk
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***Contents in Brief**—Despite a shortage of designing engineers, the Illinois Highway Department is making rapid progress in preparing plans for road construction for both now and after the war. Many plans now are complete and many more will be ready when the time comes. Much pavement rehabilitation has been necessary to keep the state's primary highways operable under severe wartime traffic. Highway maintenance and snow removal operations have shown a marked increase despite severe shortages in manpower and machinery. An increased tempo in peacetime roadbuilding, and other improvements in highway construction are predicted, resulting from experience gained during wartime.*

PREPARATIONS FOR POSTWAR roadbuilding in Illinois have passed the preliminary planning stage and, for the past several months the highway division of the state's Department of Public Works has been working at top speed to prepare complete plans and specifications on projects definitely scheduled for construction as soon as materials become available and funds are provided. It is no longer a question of planning a theoretical long-range program of highway construction designed to alleviate postwar unemployment, but rather it is a problem of rehabilitating and reconstructing many war-worn sections of highway long since beyond the stage of economical maintenance. Such construction, of course, will furnish a large amount of employment for men returning from the armed services as well as those no longer employed in war plants.

Despite sharp inroads made on the engineering personnel by the armed services and war plants, a sizable amount of highway plans have been completed to date and it is believed sufficient plans will be available to meet any reasonable construction program for after the war. An inventory of the state's primary highway system discloses the present need for construction of 203 mi. of four-lane, or wider, pavement; 1,750 mi. of two-lane pavement; 80 mi. of bituminous surfacing 167 railroad grade separations; and 21 highway grade separations. These improvements, including many necessary stream crossings are estimated to cost $188,500,000 for construction and $25,300,000 for right-of-way.

Primary road improvements

Highway construction on the primary system already programmed, with design work authorized, includes 890 mi. of concrete pavement estimated to cost $68,753,000. This program also includes 254 railroad and highway separation structures and main river bridges to cost $25,712,000; making a program total of $94,465,000. Most of the concrete pavement will be two-lane, although some four-lane or greater width pavement is planned on the more important traffic arteries. Ordinarily, each traffic lane will be 11 or 12 ft. wide.

A breakdown of this highway improvement program, for which plans and specifications are being prepared as rapidly as the department's reduced staff will permit, discloses that plans and specifications have been completed, and all right-of-way secured for the construction of 53 mi. of pavement to cost $3,240,000 and 18 major structures amounting to $2,170,000.

Plans and specifications also have been completed, but the necessary right-of-way has not been secured on 128 mi. of concrete pavement estimated at $10,388,000 and 32 important highway structures to cost $1,389,000. However, this right-of-way probably could be acquired within a fairly short time. Thus, these two sections of the highway program; the one now ready to go, and the other requiring only the acquisition of right-of-way total over $17,000,000 of construction which can very well be considered ready and waiting for peace day.

The highway survey situation in Illinois is in very good shape. This is due, in part, to a vigorous program of field surveying having been started during 1941 when highway construction first began to ease off due to the scarcity of roadbuilding materials. This work was continued throughout the past three years whenever the department's engineers were not needed for more important work. By dint of this foresightedness there now are surveys completed and design plans partially underway for 268 mi. of concrete pavement on the primary highway system estimated to cost $18,398,000 and 74 major structures amounting to $6,278,000. This part of the program, amounting to nearly $25,000,000 of construction, might also be considered available shortly after cessation of hostilities, depending, of course, on how soon the war ends.

In addition to the above highway improvements, surveys are under way for 158 mi. of primary roads including 42 important structures at a total cost of $13,627,000. Also programmed, but surveys not yet started, are 283 mi. of pavement and 88 structures that will cost in the neighborhood of $38,975,000. This constitutes Illinois' $94,465,000 postwar highway program for primary roads, some of which may need to be built even before the war ends in order to maintain an efficient wartime highway system.

In estimating the cost of the postwar program, current contract unit

Designed to span both the south channel of Rock River and the Illinois and Mississippi River Canal, this four-lane bridge will have two 300-ft. tied steel arches, with short I-beam approaches.

prices have been used, realizing that the "market" may be up or down depending upon working conditions and competition among road contractors.

While most of the highways included in Illinois' postwar program are being planned for only two-lane pavement, many of them are being designed for conversion to divided four-lane type when traffic increases to the extent to warrant it. Ample width of right-of-way is being acquired initially to provide for the additional two-lane pavement and either a center parkway or a median strip. Drainage structures are designed to permit future lengthening to accommodate the widened roadway.

Secondary roads

An inventory of the state's secondary road system discloses the need for constructing 698 mi. of medium and low type surfaces, most of which will be non-rigid pavement either asphalt-mix or oiled gravel, and many bridges. These improvements are estimated to cost $17,500,000 for construction and $1,000,000 for right-of-way. Only a partial secondary road program has been formulated, but plans have been completed for 27 mi. to cost $725,000. The fact that many secondary roads are providing access to war industries, thus carrying much heavier traffic than was contemplated in the original design, will probably result in substantial increases in needed secondary road improvement.

Postwar financing

Illinois' anticipated yearly allotment of the $3 billion federal highway appropriations bill (H. R. 2426) now pending in Congress will be about $44,000,000, which added to nearly $15,000,000 of state matching money, will make a total yearly state highway construction program of $59,000,000. Nearly twice this amount has already been programmed for orderly construction on the basis of greatest necessity, when the time comes, and full confidence is held that sufficient road plans will be prepared to keep up with the postwar program.

State funds on hand now for new highway construction total $16,000,000 which amount is expected to be increased to $24,000,000 by Jan. 1, 1945. Road-building funds are derived from the state's one-third share of the three-cent gas tax and from motor vehicle registration. Retirement of bonds, maintenance, and operating expenses use up practically all of the latter fund.

Wartime highway construction

Ordinary highway construction has been sharply curtailed during the war as shown in Table 1. Although the total work placed under contract during 1942 equalled that of 1939, the last year in which defense preparations did not affect roadbuilding, it is to be noted that the item "other construction" during 1942, was only slightly more than 10 percent of the amount shown for 1939. Throughout the 20-year period preceeding the war, highway contracts awarded averaged $21,000,000 per year. Impact of the war retarded construction undertaken until in 1943 it amounted to $12,007,000, a reduction of 40 percent below the 20-year average. Also, it is apparent that the three classes of war-necessitated construction have dominated each year's program until they have nearly eliminated all other construction.

Another aspect of the wartime program is that work listed under "other construction" is not necessarily the usual type of peacetime roadbuilding. Much of this work during the past two years consisted primarily of: (1) reconstruction of small mileages of pavement which were beyond the point of rehabilitation; (2) reconstruction of a limited amount of low-type surfaces on the verge of failure; (3) seal coating bituminous surfaces threatened with destruction; and (4) repairing damages caused by the disastrous spring floods of 1943.

Recent work

New highway construction during the past year included 66 mi. of 10-in. concrete pavement, 24-ft. wide and costing $6,400,000, in three sections between Joliet and Staunton on the heavily traveled truck route U. S. Highway 66 between Chicago and St. Louis. Other important projects included: (1) a four-lane concrete highway serving the new Chicago Chrysler plant in the southerly part of Chicago, at a cost of $818,000; (2) the network of improvements around the Great Lakes Training Station north of Chicago, which included access highways, grade separations and widening of existing pavement, totaling $444,000; (3) Camp Grant Belt improvements costing $709,000 and providing an ultimate bypass route around Rockford, Ill., as well as the present access road to Camp Grant, and (4) a new four-lane highway leading from East St. Louis toward Belleville built at a cost of $735,000.

Manpower shortage

Wartime demands of the armed services and lucrative jobs offered in war industries have sharply reduced the department's engineering personnel, as has been true throughout the country. It is not so much the number of engineers lost to the department, as it is the caliber of the men involved. Many of those who have left the state's employ were such high-grade experienced designers as to be practically irreplaceable. Another disturbing element in the manpower situation, already demonstrated by actual examples, is the fact that engineers whose services happen to be terminated in one war industry at the conclusion of its war contracts are further attracted

to other big-salaried jobs in industry or war plants. Thus, many of these men may never return to highway work.

Employees of the highway department are not under civil service and salary restrictions limit any attempt being made to compete with the high wages offered by war industries, although a recent state-wide salary survey resulted in a general upward adjustment in this respect. Also, merit raises continue to be given as the occasion justifies.

Many in armed forces

The highway department furnished 191 engineers and highly trained technical employees to the armed services up to Nov. 1, 1943. This represents a 20 percent loss in personnel, based on the 931 men in this category employed during July 1941. Personnel records disclose 534 engineers and technical men employed at present. The state also has a current highway maintenance force of 794 as compared with a normal force of 900. Twenty 5-man survey parties now are in the field, and they will be augmented by additional crews as wintertime construction decreases and releases engineers for this necessary phase of postwar planning.

Although no accurate prediction can be made of the number of engineers and technically trained employees required for after the war, a conservative estimate would be that the department will need at least 1,500 such men to provide adequate surveys, design plans and specifications to keep up with the contemplated postwar highway program.

In general, the highway department has pursued a policy during this war emergency of assigning its engineering forces where they were the most needed. Strategic and access highway projects have required considerable engineering and, of course, they have received right of way over normal construction. During the spring and summer construction seasons most of the department's engineers have been delegated to this work. Then, as construction diminishes in the fall and winter, work proceeds on the making of field surveys and the preparation of highway plans and specifications.

Legislative change needed

For many years it has been the highway department's policy not to attempt the acquisition of any right-of-way, but to let the counties, townships or other local road-booster groups provide it as their contribution to the highway improvement. Present statutory provisions permit right-of-way condemnation proceedings to be resisted over a long period of time, with subsequent aggravating delays in essential highway construction. Revisions are urgently needed in the law of eminent domain as applied in Illinois to permit speedier condemnation of right-of-way for state highway construction, and it is hoped that changes will be made soon to provide a procedure paralleling that now employed on federal highway construction.

Also, a change of policy has been agitated recently whereby the state highway department will secure right-of-way for all relocation and modernization of its existing roads, while the other road agencies furnish right-of-way on new construction. This move is designed to eliminate some of the usual bothersome delays in starting highway projects, thus speeding their completion.

Cooperative contractors

It is certain that the tempo of highway construction will be increased materially in the postwar era. This is attributed to two factors; the speedy wartime roadbuilding now being followed and an increased spirit of cooperation among contractors to get the job done. A noticeable example of the latter was displayed during the recent construction of a 24-mi. section of concrete pavement between Litchfield and Staunton on U. S. Highway 66. The extreme urgency of rapid construction on this section of heavily traveled highway resulted in frequent meetings being held on the site between highway officials and the six prime contractors performing the work, in order to expedite the job.

The remarkable feature of the entire operations was the excellent cooperation between contractors. If one of the six contracts lagged behind schedule, men and machinery were cheerfully and expeditiously furnished by one or more of the other contractors to relieve the bottleneck—a procedure which has not always been the rule in peacetime construction. Despite the short time allotted for building this 24-mi. of highway, it was completed on schedule.

Bridge building plans

Preparation of bridge construction plans has been prosecuted as rapidly as possible with a sharply reduced engineering force, many of whom have been needed on construction from time to time during the past two years. Largest single bridge project scheduled for construction as soon as materials become available and funds are provided is a relocation job between Milan and Rock Island, Ill., involving four new structures which will span five streams, at an estimated cost of $1,000,000.

Plans have been completed on all of these bridges which include a 270-ft. tied steel arch with four continuous deck steel plate girders of 95-, 119-, 119- and 95-ft. spans. This bridge over the north channel of Rock River is estimated to cost $375,000. Spanning the middle channel of the river will be a $155,000, four-span continuous deck plate girder bridge with spans of 86-ft. 8-in., 108 ft. 4-in., 108 ft. 4-in., and 86 ft. 8-in. Next in line is a bridge over both the south channel of Rock River and the Illinois and Mississippi River Canal. It will have two 300-ft. tied steel arches, one 56-ft. and a 38½-ft. steel I-beam span. Estimated cost of this bridge is $360,000. All three of these structures carry two 24-ft. roadways separated by a 4-ft. median, painted black and set flush with the roadway slabs. Four-foot sidewalks will be carried along each side of the bridges.

The fourth bridge, estimated to cost $110,000, has two deck plate girder spans measuring 83 ft. 3 in. and 92 ft. 9 in. on center line of roadway. It is to be skewed, curved, superelevated and built on a vertical curve. This bridge will carry two 4-ft. sidewalks and two 26-ft. roadways separated by a 4-ft. median. All

TABLE 1 — COMPARISON OF HIGHWAY CONSTRUCTION EXPENDITURES

Year	Access Roads	Strategic Highways	Pavement Rehabilitation	Other Construction	Total
1939	None	None	None	$18,547,000	$18,547,000
1940	None	$2,132,000	None	13,990,000	16,122,000
1941	$846,000	2,455,000	$276,000	6,683,000	10,260,000
1942	4,446,000	3,706,000	8,338,000	2,324,000	18,814,000
1943	1,496,000	2,707,000	6,763,000	1,041,000	12,007,000

four bridges in this project have been designed for an H-20 loading according to provisions of the A.A.S.H.O. specifications, using a concrete design stress of 1,200 psi. and a steel stress of 18,000 psi.

Another bridge ready for construction is on the Kankakee Belt over the Kankakee River. This $350,000 structure will have 12 reinforced concrete deck girder spans.

Increased maintenance

Highway maintenance in Illinois during the past two years has been a continual battle against increasing wartime truck loads and other destructive elements—a battle not to rehabilitate the roads to their prewar standards, but merely to keep them in good operable condition and to prevent their deterioration from progressing so rapidly that structural failures would become imminent. Truck transportation of heavy equipment and materials for army cantonment and war plant construction, together with the general trend toward heavier freight loads operating over large mileages of the older pavements undoubtedly has caused road surface failures to accumulate at an alarming rate.

Equipment adequate

Maintenance equipment now in use by the department is believed to be adequate for ordinary wartime needs, but there is grave danger of a bottleneck developing from the lack of sufficient repair parts. Additional repair parts must be made available in 1944 by WPB approval, as well as additional reconstruction of highways authorized, to maintain a safe and efficient wartime highway system.

One blessing in disguise resulting from increased maintenance during this emergency is the development of closer contacts between designing engineers and maintenance men. Shortage of maintenance engineers required the drafting of design and construction engineers to help with the work, resulting in their becoming widely acquainted with maintenance methods and requirements.

State-owned snow removal equipment is deemed adequate providing repair parts can be obtained as needed. The threatened bottleneck in this field is a shortage of manpower. Here, again, the building of several war plants away from main highways has required the keeping of many secondary roads open and safe at all times for crowded traffic. In ordinary times these highways carried little traffic and did not require extensive snow removal.

An inventory of state-owned construction equipment shows very little on hand; four bituminous outfits are used for sealing and patching, one small concreting outfit capable of building pavement gaps about one-half mile in length, ditch-cleaning machinery and equipment for building guard rail. It is expected that a portion of excess government-owned roadbuilding equipment will be available at the end of the war. A nominal amount of such equipment can be utilized for maintenance work but only a small amount will be needed for new construction, as the state greatly favors the contract method of highway construction to that of day labor.

Highway reconstruction

Programming of highway reconstruction is established on a nondisputable basis of the cost of continued maintenance on the sections of road in question versus the cost of their replacement. Continual maintenance-cost records are kept of the older highways subject to heavy traffic and undergoing progressive deterioration. Sections of highway to be reconstructed are selected from this data for inclusion in the current highway program in order of their greatest necessity. One important fact established by these cost surveys is that the volume of commercial traffic bears a constant ratio to maintenance costs; when truck traffic increases on any section of highway, maintenance costs rise, and likewise when freight traffic decreases a corresponding decrease in maintenance cost is noted.

Bridge painting by contract

One item of wartime maintenance that bids fair to become an established peacetime practice is the painting of existing bridges by contract instead of by state forces. Although manpower shortage has necessitated bridge painting by contract during the past two years, it has met with considerable success, and such procedure has several advantages: (1) The work can be contracted to well-equipped paint crews in lieu of continually training maintenance men for the job; (2) large river bridges need considerable painting equipment and skilled men; (3) much of the painting can be distributed to local contractors throughout the state, thus permitting completion of the entire program in a short time; and (4) contracting of the state's bridge painting will release men and equipment urgently needed for more important maintenance work.

City streets and county roads

City and county road planners are being urged by the Division of Highways to vigorously prosecute plans for postwar construction. Particular emphasis is placed on the adoption of long-range programs for county roadbuilding and city street improvements covering from four to five years. Much of this essential planning, particularly by the larger cities, is now in the final stages of design preparation and large projects will be made ready to proceed with construction when the time comes.

The initiative for county road and city street planning lies with the counties and cities, with the highway department being authorized by law to act only in an advisory capacity, to approve construction plans and expenditures. In addition to preparing plans for projects scheduled for early construction, considerable attention is being given throughout the state to arousing public interest in future construction. Early crystallization of public opinion as to the types of roads and street improvements needed the most, as well as their locations, will simplify the final preparation of postwar plans.

Administration of Illinois' Department of Public Works and Buildings, Division of Highways, is ably supervised by Walter A. Rosenfield, director. He is assisted by I. A. Palmer. The author is chief highway engineer and V. L. Glover is assistant chief highway engineer. Bureau chiefs in charge of engineering work include: H. E. Surman, engineer of design; E. D. Dryfoose, road engineer; G. F. Burch, bridge engineer; D. D. Starke, acting engineer of railroad crossings; H. W. Russell, engineer of materials; C. M. Hathaway, engineer of construction; C. W. Ross, engineer of maintenance; Geo. H. Baker, engineer of county roads and city streets, and F. N. Barker, engineer of highway research.

Highway Bridge Repaired Under Traffic

RECENT REPAIR by the Arkansas State Highway Department of a damaged highway bridge while traffic was maintained is of interest because of the success of the methods followed. The work is of further interest because the structure is of a size common to the older roads of all sections of the country.

The bridge is a two-span, through-truss, all-rivited crossing constructed in 1926 over Fourche Creek on Route 65 at the south edge of the city of Little Rock. Designed for an H15 loading, the bridge has a 9-in. thick reinforced-concrete deck supported on steel stringers. An 18-ft. clear roadway is provided. Span of the trusses is 115 ft.

The driver of a large truck transporting a buldozer with a 13-ft. blade dropped to sleep while passing north through the south span of the bridge. The truck swung into the left lane of the span and the buldozer blade sheared one of the two channels forming the first vertical at the north end of the west truss and placed a 3-ft. bow in the end post.

East truss also damaged

When it struck the end post, the bulldozer was thrown from the truck against the corresponding end post of the east truss, knocking this member 4 in. out of line. This post was damaged so badly that a 4-ft. long section had to be cut out and replaced. In addition, the end floorbeam was knocked out of line and the bottom chord of the west truss was bent in the first panel. Damage was sufficient that the west lane had to be closed to traffic and use of the east lane restricted to light loads.

Repair of the west truss included installation of a new end post and hip vertical, splicing of the bottom chord in the first panel and straightening the end floorbeam. Only repair to the east truss was the end-post splice previously mentioned.

As a first repair operation, heavy timber falsework bents surmounted by 50-ton screw jacks were placed under the first three panel points at the north end of the damaged span. Once the falsework was in place, both lanes were opened to heavy traffic and the repairs were made with traffic maintained.

The plan followed was to raise the first three panel points on the west side and repair this truss before transferring operations to the east side. Although the total bearing area of the mud sills of the three bents was 320 sq. ft., jacking operations continued two days before sufficient bearing was obtained on the soft streambed to lift the north end of the west truss. During the jacking, the east jacks were extended almost as far as the west ones in order to keep the mud sills nearly level as they were forced downward.

The hip vertical and the end post at the north end of the west truss were so badly damaged that they had to be replaced.

With the roadway at the west side of the bridge carried on the falsework bents, the old hip vertical was removed and the new one inserted and bolted in place at the top. Because of its stiffness, the deck did not deflect under its own weight when the jacks were lowered at the first panel point, which prevented the vertical from sliding into place at the bottom. This problem was solved by leaving the jacks a few inches low under the first panel point and driving a heavy truck slowly onto the west roadway. This weight caused the deck and the lower chord to deflect sufficiently to permit the lower end of the post to be swung into place.

Post erected in two sections

Erection of the new end post in two sections was the next operation. First, the top section was raised into position and held at the top by a couple of bolts. After the lower section had been added and fastened by the same method, the jacks at all three panel points were extended until the hip panel point was raised a couple of inches, which permitted the milled splice in the end post to be made. Addition of the remaining bolts at both ends of the end post completed erection of this member.

With the new post in place the damaged section of the bottom chord in the first panel of the west truss was cut away and replaced with a new piece of steel. This work completed repair of the west truss.

To repair the end post of the east truss, the jacks under the first three panel points of that truss were extended until the compressive stress in the post was reduced to zero. Next the damaged portion of this member was cut away with oxyacetylene torches and the new section, which was about 4 ft. long, inserted completing the repair operation. To insure perfect bearing of the old end post to the new section, the two splices were welded with an electric torch.

Repair of the bridge required four weeks with maximum crew of about 25 men employed. Cost of the work was $2,500. It was done by the maintenance forces of the highway department, for which W. W. Mitchell is director, and N. B. Garver, bridge engineer. John Strom, senior highway engineer supervising heavy bridge maintenance, was in direct charge.

Simplified Tests for Soil Bearing Pressure

E. G. Whitten
Resident Engineer, Tuttle, Seelye, Place & Raymond, New York City

A PROCEDURE for making field load bearing tests that is believed to be simpler, faster and less costly than those now in common use has been developed at Ft. Dix, N. J. This testing set-up differs considerably from those previously described in technical literature. The method illustrated in *Engineering News-Record*, March 25, 1943, p. 431, is complicated, requiring the use of four trucks and three heavy beams. The procedure described in *Civil Engineering*, July 1942, p. 390, among other disadvantages, necessitates an awkward position for the operating crew. A method described in *Bomber Flying Fields* (Construction Series 59 of the Asphalt Institute) requires the unloading of trucks and dis-assembly of two heavy U-bolts and reloading and re-assembly before another test can be made. All of these disadvantages are overcome with the Fort Dix procedure.

Rapid work is possible with the simplified method, three hours being required to set up the equipment and make a test. Four laborers are required for the assembly work, and one engineer and a technical assistant are needed to supervise the test and to record the data. Required equipment includes that listed in the accompanying table, plus two loaded trucks to provide a reaction against uplift, and a truck equipped with a winch to set up the test equipment.

REQUIRED EQUIPMENT

Item	Cost
One 50-ton hydraulic jack with gage	$120
Two Ames dials of .001-in. sensitivity	50
Two dial holders	10
One 15-in. wide-flange beam 20 ft. long (reinforced)	150
One 4-in. dial beam (channel) 20 ft. long	15
One 30-in. dia. bearing plate 2½ in. thick	40
One 16x11x2-in. jack plate	10
Misc. rollers, blocks and tackle	25
Total	$520

Use of the equipment is illustrated by Fig. 1. When tests of subgrade are made, the trucks are loaded to sustain a total uplift of 35 tons; for pavement tests a 60-ton uplift must be sustained. A 30-in. dia. circular bearing plate is used for subgrade and a 24-in. plate for flexible pavements. In both types of tests a thin layer of fine, dry sand is added under the plate to provide more uniform loading.

Application of the load

Application of the load for a subgrade test is as follows: A load of 3,500 lb. is applied and released to seat the plate. The readings of An

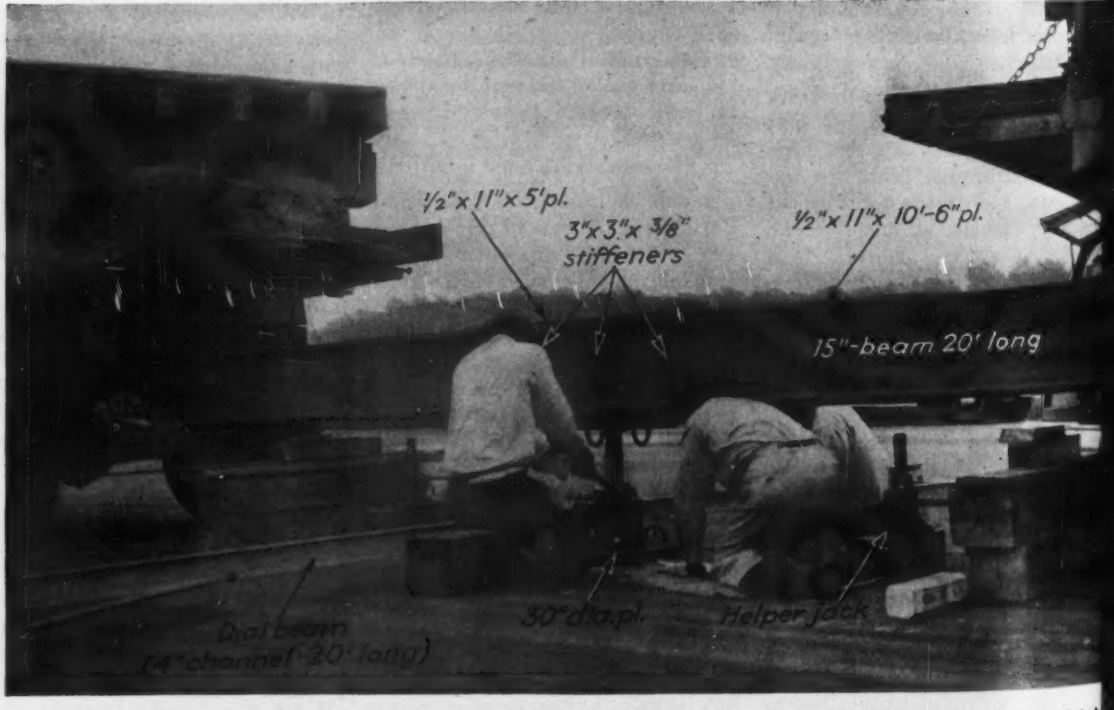

Fig. 1. Bearing test equipment used at Fort Dix can be set up quickly. It permits rapid work with a small crew. Note freedom of movement permitted workmen.

ials and the time are then recorded. The test load is applied in 5,000-lb. increments, allowing deformation to end before the next increment is applied; a wait of 10 to 15 minutes is usually necessary. The two dials are read and the mean settlement then computed. The time interval and deflection for each subsequent 5,000-lb. increment is recorded. After applying a total load equal to about 1½ times the wheel load of the heaviest airplane expected to use the airfield, the load is released in one increment. The dials are again read to record the permanent deflection.

The procedure followed for testing flexible pavement is much the same, except that a 2,200-lb. load is applied and released to seat the equipment.

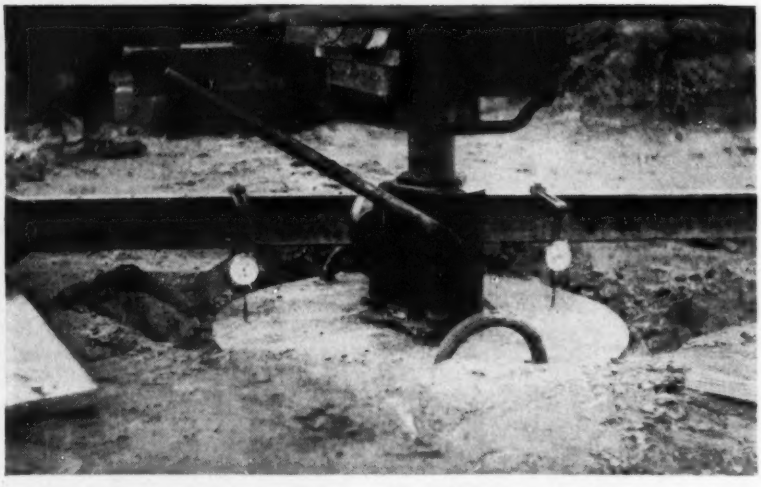

Fig. 2. Settlement of the bearing plate is measured by two Ames dials attached to a 20-ft. channel resting on rigid end supports.

Making use of results

To make use of the data obtained, load deformation curves are prepared. From these curves the modulus of subgrade reaction, K_U, is determined by the formula $K_U = P \div 0.05$, in which P is the load in pounds per square inch causing a deflection of 0.05 in. If the soil is non-cohesive sand or gravel, the value of K_U can be used directly. For other soils, the subgrade should be saturated before the test is made or a correction for saturation should be determined by the consolidation test and applied to the results.

The thickness of a rigid pavement necessary for any wheel load can be determined directly from tables published by the Portland Cement Association or from those used by the U. S. Engineer Department, once the value of K is determined. The tables referred to are graphic applications of the solution of the Westergaard analysis to determine interior slab thicknesses.

The necessary edge thickening for a pavement is determined by empirical methods. Both the U. S. Engineer Department and the Portland Cement Association have developed simple formulas for edge thickening in the center thickness of the slab has been determined. Also, both organizations have developed tentative methods to determine the slightly thicker slab necessary if a uniform edge thickness is planned.

If it is desired to correlate the data obtained with the California Bearing Ratio test, an undisturbed sample of the soil should be secured adjacent to the test location. The density and moisture content of the soil at the test site should be determined to compare with maximum density and optimum moisture content. Also, in most cases, soil samples sufficiently large for the Atterburg limit tests and mechanical analysis will be desired.

The test equipment described herein was used under the supervision of Lt. Col. D. R. Neff, executive officer, Corps of Engineers, Philadelphia district, Lt. Col. Clyde B. Pyle, area engineer for the U. S. Engineers, and Aksel Jorgensen and the writer, project manager and engineer, respectively, for Tuttle, Seelye, Place & Raymond, New York architect-engineer for the Fort Dix improvements.

Salt on Steel of Coastal Bridges

Sodium chloride deposits on steel are now given attention before repainting steel bridges along the California shoreline. This practice, on which there has now been several years' experience, began after discoveries made on the San Francisco-Oakland Bay Bridge. On that structure maintenance is largely a matter of painting. When paint failures on eyebolts were noticed and a white powder was observed to form at the junction of concrete and metal, laboratory analyses were made and the powder was identified as NaCl. These deposits could not be removed by brushing or wiping with a mineral thinner.

Thereupon, various portions of the bridge surface were washed with distilled water and the washings were analyzed. It was found that the steel surface had salt deposits that stayed there as a coating in intensities varying from a trace to 71 mg. in an area of 2¼ sq. ft. This area was arbitrarily adopted as a standard for purposes of comparison. It is an area convenient for washing with 8 oz. of distilled water, using a clean cheesecloth for each successive area from which the test sample is to be taken.

Experience with the salt deposit has led to the conclusion that the best treatment is washing with water. Flame cleaning of steel does not entirely remove salt and even after sandblasting on old structures, distilled water tests showed some salt remaining, perhaps in pitted parts of the surface. In one case bridge steel at an inland location was found to have salt deposits on the surface accumulated during a steamer trip from the East Coast.

All these indications led to the now well established practice of washing steel with water just before painting if there has been any considerable exposure to salt fogs. When a paint crew goes out on a coastal job it takes along facilities for making qualitative tests. If more than a trace of salt is present, the surface is washed with water before it is painted.

New Hampshire Timber Bridges Rebuilt

H. E. Langley
Bridge Engineer, New Hampshire State Highway Department, Concord, N. H.

DUE TO EXTENSIVE LUMBERING operations many of New Hampshire's light timber bridges that normally carry only 4 to 6-ton loads have recently been subjected to loads of 15 tons or more. Several of these crossings are long-span, covered structures which in their more than 50 years of service received little maintenance, except for renewal of the floor system and roofing. The increased loads, in conjunction with deterioration, have made necessary reconstruction of many of the crossings, one of which spans the Pemigewasset River in the town of Woodstock.

This bridge has a clear span of 182 ft. and a clear roadway of 14.6 ft. Its superstructure, of excellent quality native spruce, consists of lattice trusses with double chords, plus a laminated timber arch at each side extending below the floor system at the abutments. The floor system is made up of laminated flooring over 6 x 12-in. timber floorbeams on about 2-ft. centers and bearing directly on the lower truss chord, which is connected to the arch ribs by tie rods on roughly 5-ft. centers. Lateral and sway bracing is used in the plane of the upper top chord of the trusses and lateral bracing in the plane of the bottom chord.

Connections of the lattice and chord members of the trusses are made by means of 2-in. dia. red or white oak dowels. The laminated members of the arch ribs were spiked together during fabrication, after which bolts on about 5-ft. centers were used to prevent separation of the members under stress.

Extensive damage had occurred

Over the years, the bridge became wracked out of its original shape. The trusses had lost much of their original camber and showed considerable lateral deflection. Lack of sound timber at the ends of the arches l placed the larger part of the fl loads on the trusses, which in t made the truss upper chords buc and take the form of a series of wa for their entire length. Also, t additional dead load plus increa live load, had caused the splices the lower chords of the trusses to pand. In addition, both lateral a vertical deformation of the arches h occurred.

A careful inspection indicated t all members of the floor and braci systems had to be replaced, and t some members of the trusses a arches at the abutments required newal. It appeared probable that t arches and trusses could be realign and brought back to their origi shape while this reconstruction was progress. To accomplish this wo it was necessary to carry the ent superstructure on falsework.

Fortunately, the stream bed at t

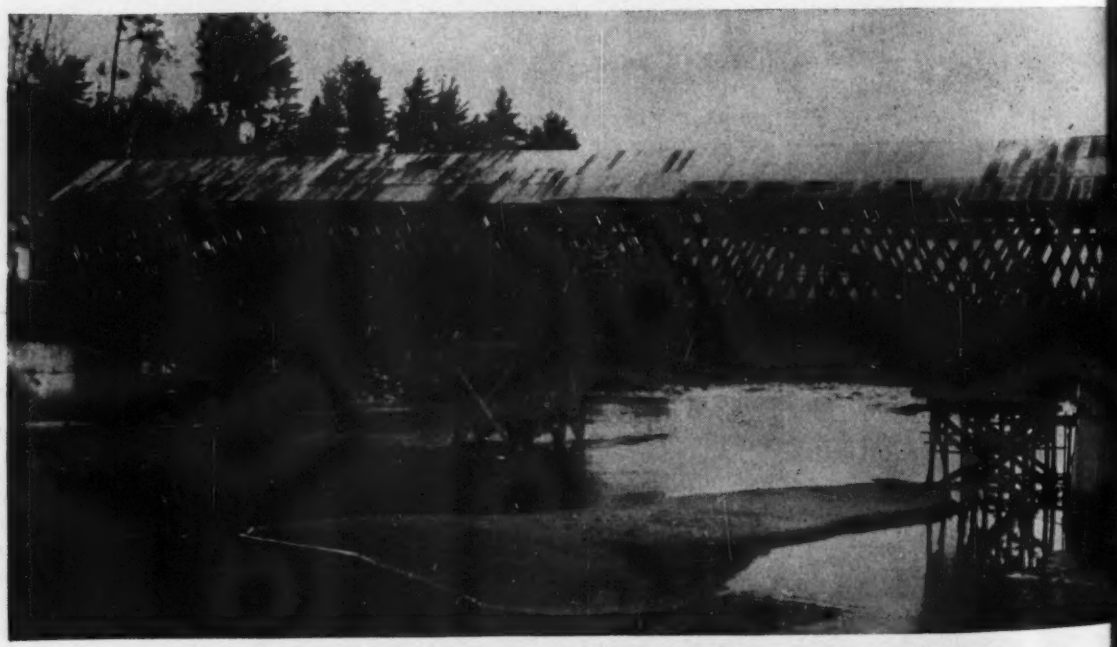

Fig. 1. Timber falsework was first installed to permit the bridge to be raised clear of the abutments.

Fig. 2. The Pemigewasset River Bridge had been wracked out of its original shape, the arches showing both lateral and vertical deformation.

location is a firm strata of sand and gravel 15 ft. deep over solid rock or densely packed boulders. As a first operation, a series of three timber bents were placed at each abutment and a double bent at the center of the span, the timber bearing piles being jetted to a firm support with little difficulty. All the bents were braced in both directions and provided with 12 x 16-in. timber caps.

When the falsework was in place, the entire superstructure was jacked up until the trusses and arches were free of the abutments. Rolls were inserted between the jacking sills at one end to aid in the future realignment of the superstructure.

As a first replacement operation, all damaged or deteriorated portions of the lower chords and truss lattice system were renewed. The lattice members were cut off at their lower ends and the new portions were spliced to the old, bolts and red oak dowels being used.

Next, portions of the end of one arch were removed by sawing through the laminations with the cuts staggered about 5 ft. It was interesting to note that the free ends of the laminated pieces had a pronounced tendency to fan out in a lateral direction, indicating the ribs had been subjected to a severe twisting strain for a long time.

After the trusses and arches had been repaired, the bridge was brought into correct alignment, and the rolls removed and replaced with blocking to prevent any displacement. Finally, after removal of the rolls, the new floor and lateral systems were added.

Repair operations required 15 weeks and cost $9,000 including materials and labor. The work was done by the maintenance division of the highway department under the general supervision of H. E. Langley, bridge engineer. The repair crew varied from eight to four men. With one exception, all of these men were 50 or more years old, which shows how maintenance crews in New Hampshire have been depleted of younger men.

Fig. 3. Arches extend below the floor system at the abutments to rest on a concrete pier encasement built a few years ago.

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Extensive damage had occurred

Over the years, the bridge became wracked out of its original shape. The trusses had lost much of their original camber and showed considerable lateral deflection. Lack of sound timber at the ends of the arches h placed the larger part of the fl loads on the trusses, which in tu made the truss upper chords buck and take the form of a series of wa for their entire length. Also, t additional dead load plus increas live load, had caused the splices the lower chords of the trusses to e pand. In addition, both lateral a vertical deformation of the arches h occurred.

A careful inspection indicated th all members of the floor and braci systems had to be replaced, and th some members of the trusses a arches at the abutments required r newal. It appeared probable that t arches and trusses could be realign and brought back to their origi shape while this reconstruction was progress. To accomplish this wor it was necessary to carry the enti superstructure on falsework.

Fortunately, the stream bed at t

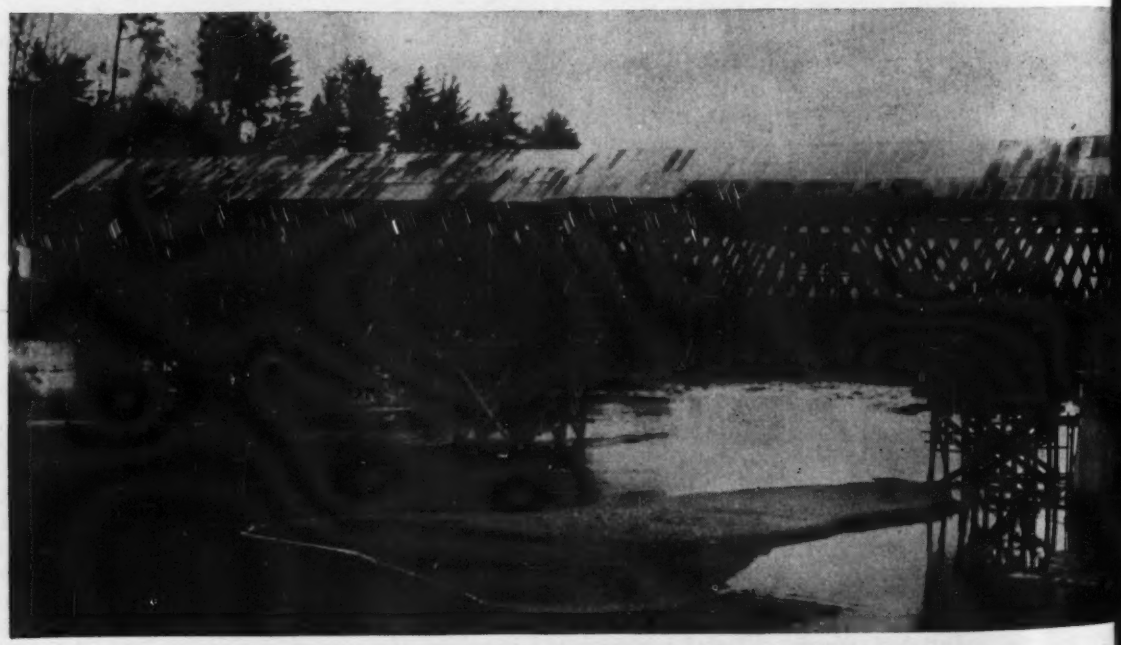

Fig. 1. Timber falsework was first installed to permit the bridge to be raised clear of the abutments.

Fig. 2. The Pemigewasset River Bridge had been wracked out of its original shape, the arches showing both lateral and vertical deformation.

location is a firm strata of sand and gravel 15 ft. deep over solid rock or densely packed boulders. As a first operation, a series of three timber bents were placed at each abutment and a double bent at the center of the span, the timber bearing piles being jetted to a firm support with little difficulty. All the bents were braced in both directions and provided with 12 x 16-in. timber caps.

When the falsework was in place, the entire superstructure was jacked up until the trusses and arches were free of the abutments. Rolls were inserted between the jacking sills at one end to aid in the future realignment of the superstructure.

As a first replacement operation, all damaged or deteriorated portions of the lower chords and truss lattice system were renewed. The lattice members were cut off at their lower ends and the new portions were spliced to the old, bolts and red oak dowels being used.

Next, portions of the end of one arch were removed by sawing through the laminations with the cuts staggered about 5 ft. It was interesting to note that the free ends of the laminated pieces had a pronounced tendency to fan out in a lateral direction, indicating the ribs had been subjected to a severe twisting strain for a long time.

After the trusses and arches had been repaired, the bridge was brought into correct alignment, and the rolls removed and replaced with blocking to prevent any displacement. Finally, after removal of the rolls, the new floor and lateral systems were added.

Repair operations required 15 weeks and cost $9,000 including materials and labor. The work was done by the maintenance division of the highway department under the general supervision of H. E. Langley, bridge engineer. The repair crew varied from eight to four men. With one exception, all of these men were 50 or more years old, which shows how maintenance crews in New Hampshire have been depleted of younger men.

Fig. 3. Arches extend below the floor system at the abutments to rest on a concrete pier encasement built a few years ago.

Fig. 1. Dividers spaced about 12 ft. apart have many advantages in converting an existing road into a divided highway.

Dividing Urban Highways

R. N. Ricketts
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Delaware, Ohio

***Contents in Brief**—Precast concrete dividers spaced 12 ft. apart and set at an angle of 45 deg. to the lines of traffic have been installed near Columbus, Ohio, to form a divided highway at about one-third the cost of a continuous divider. This type of divider has several advantages over continuous raised dividers in urban areas, especially when a three-lane highway is being widened.*

A METHOD FOR SEPARATING opposing lanes of highway traffic that was applied recently by Ohio Department of Highways to two main routes leading into Columbus has much to commend it for use in congested areas where the right-of-way is limited and where frequent crossing of the median zone is necessary to give access to abutting property. It consists of small dividers faced with white concrete set in recesses cut at intervals along the center of the pavement, as shown in Fig. 1 and 3. To the motorist traveling along the highways these dividers appear to form a continuous wide white division between the opposing lanes that is slightly raised above the pavement, yet the median zone can be crossed in leaving or entering driveways with as much ease as if it were flush with the pavement.

In urban areas where frequent access to abutting property is necessary the median is sometimes designed flush with pavement. While this type of median is more permanent than paint lines, its function is the same, and it is not a wholly satisfactory channelizing means. Flush medians and paint must usually be supplemented by fear of punishment because they have no physical, and only a limited moral restraining influence.

We therefore felt that a raise type of median of some type was necessary. Many shapes, designs and ideas were considered. Models of some of the best were made and studied, each being compared as to cost, degree of separation provided, adaptability to the pavements in place, ease of construction, ease of access, day and night visibility, maintenance of roadway and median and type of material required. From this study was created a design for an urban divider that we feel has some very commendable features. (Fig. 2).

The divider is 2 ft. 5 in. long out to out, and 1 ft. wide, both measurements being at the surface of the pavement. Since the divider has to be poured in an inverted position, the base is made one-quarter of an inch greater in both width and length than the top to permit easy removal of the forms. The center of the divider is 2½ in. higher than the surface of the pavement with the ends and sides sloping in a distance of 6 in. to a height of one-half inch above the sur-

face of the pavement on all sides. The depth of the divider below the surface of the pavement is two inches. This dimension may be varied to fit conditions.

One important principle of medial design is visibility. Any obstruction placed in the pavement must be clearly visible at all times. The advantages of chalk white concrete, especially when used in connection with a black pavement are well known, as is the increase in visibility that is created by scoring the concrete in such a manner that the driver's lights are reflected back to him when driving at night. Also, the effectiveness of proper scoring is increased on rainy nights, when it is most needed. Though a film of water flowing over the reflecting faces of the divider cuts the angle of diffusion to a narrow range, it correspondingly increases the intensity of reflection.

The scoring on the median divider adopted consists of ten closely spaced depressed panels with sawtooth faces. This type produces a stereoscopic effect that makes the divider appear to be about four inches in height.

Precast dividers preferred

As a general rule precast curb or median give better results than cast-in-place units, where scoring is used, because of smoother and denser concrete surfaces produced, and also because the critical angle of the reflecting faces is accurately controlled by the mold. The divider adopted for the Ohio work is precast and is made of gray concrete, topped with a one inch white-cement mortar, using white waterproof cement and light colored aggregate. This type of divider is easily adaptable to precast construction since the unit is small and easy to handle.

Two ¾-in. holes are cast in the dividers for the full depth to facilitate placing of them in their proper position in the pavement. After placing the divider, these holes are sealed with sand and a ball of asphalt.

The dividers are spaced 12-ft. center to center, and set on an angle of 15 deg. with the center line and sloping with the direction of traffic. This spacing and angle have two functions. First, a motorist traveling at a moderate rate of speed, and watching the road some 200 ft. ahead, sees a median that looks solid. Second, the angle and spacing are such that a vehicle that is weaving in between them will strike a corner of the front and rear divider, warning him that all is not well. The dividers produce a staccato sound when run over that is disconcerting but not dangerous at moderate speeds.

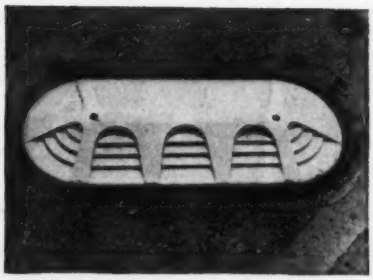

Fig. 2. The dividers are cast with a white concrete top scored to reflect light at night.

After the dividers are placed, a paint strip is placed on each side to improve the general appearance of the median and help to convey the idea of a solid no-crossing zone.

Advantages over solid dividers

In urban areas this type of medial divider has three distinct advantages over the solid or continuous type of raised median.

(1). It is possible to place this type of median on existing pavements, which are wide enough for traffic needs but need dividing, with very little loss of existing pavement. They are particularly advantageous where the existing pavement is a three lane of a comparatively high type and in good condition. It is possible with this type of median to merely widen the existing pavement to the desired width and place the dividers in their proper position regardless of where they are placed on the crown. Drainage is not a problem with this type, whereas with the solid type a drainage system in the median itself or a wedge course to correct the crown is needed, both of which are expensive.

(2). A solid median in an urban section would have to be opened quite frequently at drives, side streets and alleys, causing a series of short lengths of median which tends to reduce the effectiveness of a median. With this type, it is not necessary to open the median except at heavily traveled side streets (Fig. 1) since it is possible for a turning vehicle to either straddle a divider or run over them without too much discomfort.

(3). The cost of a solid reflecting type median is approximately three to four times as great as with this type.

Another possible use for dividers of this type would be at important intersections to channelize traffic at a relatively small cost.

At the present, the dividers have been installed on Route U. S. 23 north of Columbus and on U. S. 40 east of the city and are performing in a very satisfactory manner. The dividers used on Route U. S. 23 were manufactured by the Permacrete Products Corp. of Columbus, Ohio.

Fig. 3. To drivers the median zone appears continuous, yet cars entering from a driveway can cross without trouble, as indicated by the tracks on the pavement in the foreground.

Calculating-Machine Computation Of Vertical Curves

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VERTICAL CURVES can be computed on a calculating machine of the shifting carriage type by considering the curve as a series of chords connecting the points at which elevations are desired. The rates of grade of the successive chords can be computed on the machine followed by the computation of the elevations desired. At the P.V.C. and the P.V.T. an imaginary chord of zero length is inserted having the same rate of grade as the tangent.

In the profile AB of the curve shown, the elevations in parentheses are to be computed, all the other data being given.

In Table I, which records the results of the computations, Columns B and C are used merely for convenience of exposition, while Columns D and E list the results that are to be obtained on the machine as hereinafter described.

A curvature factor is first obtained by dividing the total difference in grades by twice the length of the curve in stations; or $\frac{2.88 - 1.36}{2 \times 1.184} = 0.6419$.

The entries listed in Column D, Table I are computed on a ten-place machine as illustrated in Table II. The lower or total register on the carriage carries both stations and rates of grade; and is started off showing the station of the P.V.C. (7 + 42.8) and the gradient of the tangent (1.36 percent). For Operation 1-a the keyboard shows 100000.0000 plus the curvature factor, or 100000.0000 + 0.6419 = 100000.6419.

The calculating machine is now run to advance the station (Column D-1) by two of the intervals listed in Table I, Column A, to station 7 + 62.1. At the same time the rate of grade (Table II, Column D-2) will advance from that of the tangent (or imaginary chord) to that of the first real chord of the curve, or 1.4839 percent, which is entered in Table I, Column D. Having advanced the station by two intervals, it is necessary to adjust the machine back by one of these intervals before carrying the work ahead. Operations 1-b and 1-c show one way of doing this which has the advantage of not disturbing the setting of the curvature factor on the keyboard. This series of operations is repeated until Operation 4 checks on the tangent ahead. If the curvature factor had been negative, as in the case of AC in the dia-

TABLE I—RESULTS OF CALCULATING MACHINE COMPUTATIONS OF GRADES AND ELEVATIONS OF VERTICAL CURVE ILLUSTRATED.

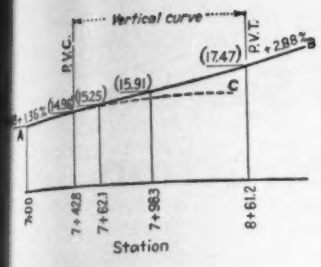
A Station	B Length of chord	C Length of two successive chords		D Rate of grade P. C.	E Elevation	Remarks
7+00.0				+1.36	14.38	
P. V. C. 7+42.8	0	.193		+1.36	14.962	Imaginary chord
7+42.8	.193		.555	+1.4839	14.962	
7+62.1	.362	.991		+1.8401	15.248	
7+98.3	.629		.629	+2.4763	15.915	
8+61.2	0			+2.88	17.472	Imaginary chord
P. V. T. 8+61.2					17.472	

Unit of length used in columns B and C is 100 ft. Entries in Column D are taken from the computations listed in Table II, Column D-2. Entries in Column E are taken from the computations listed in Table III.

TABLE II—CALCULATING MACHINE ENTRIES IN COMPUTING RATES OF GRADE (COLUMN D, TABLE 1).

A Operation No.	B Keyboard	Carriage C Upper (Counting) Register *	Carriage D Lower (Total) Register ** D-1 Station	Carriage D Lower (Total) Register ** D-2 P. C. of grade	Remarks
			−−007.428	0 1.36000000	Starting position
1-a	100000.6419	+000000.1930	−−007.621	0 1.48388670	
b	762100.6419	−000001.0000	−−000.000	0 x.xxxxxxxx	
c	742800.6419	+000001.0000	−−007.428	0 1.48388670	
2-a	100000.6419	+000000.5550	−−007.983	0 1.84014120	
b	798300.6419	−000001.0000	−−000.000	0 x.xxxxxxxx	
c	762100.6419	+000001.0000	−−007.621	0 1.84014120	
3-a	100000.6419	+000000.9910	−−008.612	0 2.47626410	
b	861200.6419	−000001.0000	−−000.000	0 x.xxxxxxxx	
c	798300.6419	+000001.0000	−−007.983	0 2.47626410	
4-a	100000.6419	+000000.6290	−−008.612	0 2.88001920	Checking on grade of next tangent.

* Unit of length used is 100 ft. The + and − signs indicate whether this motion is adjusted to count additions or subtractions. Upper register is assumed to be cleared after each time the machine is run.
** Entire lower register is not tabulated, omissions being indicated by dashes −−. Digits indicated by x have no significance.



Vertical curve used to illustrate the solution of this type of problem by means of a calculating machine.

TABLE III—CALCULATING MACHINE ENTRIES IN COMPUTING ELEVATIONS (COLUMN E, TABLE 1).

A Operation No.	B Keyboard	Carriage C Upper (Counting) Register *	Carriage D Lower (Total) Register **	Remarks
		0000007.000	−−0014.3800000	Starting position
5	000001.3600	+0000007.428	−−0014.9620800	Retain entries on the upper and lower registers after each operation throughout. Keyboard to be changed as indicated.
6	000001.4839	+0000007.621	−−0015.2484727	
7	000001.8401	+0000007.983	−−0015.9145889	
8	000002.4763	+0000008.612	−−0017.4721816	

* Unit of length is 100 ft. ** The entire lower register is not used as indicated by dashes.

...am, the entry on the keyboard ...ould have been 100000.0000 — ...6419 = 099999.3581.

Finally the elevations are obtained ... shown in Table III. Starting with ...e station showing in the upper reg...er and its elevation in the lower, ...e stations and elevations are ad...nced simultaneously by placing the rate of grade on the keyboard. Negative grades are handled by adjusting the upper register to count subtractions instead of additions. These results are entered in Table I in Column E.

In the explanation for Table II the figures in the upper register (Column C) were not used. However these figures are the same as those in Table I, Column C, being the combined length of two successive chords. In many cases these lengths are so easily obtained mentally that it is more convenient to omit the stations from Table II, Column D. If this is done the work of adjusting the stations is eliminated.

...raffic Divider Experiment Conducted At Seattle, Wash.

...Experiment is being made in Se...le, Wash., with a type of precast ...ncrete medial divider designed to ...ve a variety of uses in traffic control. The purpose was to develop a single standard unit useful for medial strips of variable widths, shearing lines, channelizing ribs and islands.

...cast concrete medial dividers, set at an angle, are used on Montlake Blvd., ...ttle, as part of a traffic control experiment. As top photo shows, dividers have ...tical surfaces that reflect headlights from any angle.

Although preliminary tests have been favorable enough to encourage several installations in Seattle, the type selected is regarded as experimental until it has been in use for a considerable period of time.

The design shown in the accompanying illustrations was chosen, after many comparisons, because of four advantages: (1) Vertical surfaces incorporated into ends and sides that provide for headlight reflection, making the surfaces conspicuous from any angle of approach. (2) Symmetrical construction that makes the units serviceable for right-hand, left-hand or terminal positions without use of specials. (3) The ease with which traffic can cross over the medial lines in emergencies at slow speed and (4) Ease and speed with which these units can be installed—they weigh only about 100 lb. each and can be easily handled by two men. They are set on a bed of portland cement and sand about ¼ in thick, without the use of dowels.

Proof of the prominence with which these markers stand out on the roadway is afforded in complaints, received from a number of motorists stating that "12 or 14 in. is too high for dividers of this type." The actual height is only 6 in.; plan dimensions are 16x34 in.

These units were designed by J. W. A. Bollong, traffic engineer, city of Seattle, Wash.

An Interregional Highway System Proposed for Postwar Construction

C. S. Hill
Associate Editor (Retired), Engineering News-Record

***Contents in Brief**—Creation of an interregional highway system of 33,920 miles by the reconstruction or relocation of outmoded highways is proposed to Congress by the President in approving the report to him of the National Interregional Highway Committee. Work on the system would be undertaken as a postwar project and carried forward at the rate of about $750,000,000 a year for several years. Costs would be divided about equally between the states and the federal government.*

Provision of an interregional highway system of 33,920 miles, to serve 20 percent of the nation's highway traffic, to require a construction expenditure of $750,000,000 a year and to furnish 468,500 man-years of employment a year is the ambitious task proposed as an immediate postwar undertaking by the National Interregional Highway Committee. The proposed work would include modernization of some existing routes and construction of new highways where modernization is impracticable.

Committee appointed in 1941

The National Interregional Highway Committee was appointed by the President in April, 1941, following the introduction into Congress of one of the perennial bills to authorize construction of a system of transcontinental toll superhighways as a postwar undertaking (*ENR* April 17, 1941, p. 574). The committee consisted of Thomas H. MacDonald, Commissioner of Public Roads, subsequently elected chairman; G. Donald Kennedy, then state highway commissioner of Michigan; Bibb Graves, former governor of Alabama; C. H. Purcell, then state highway engineer of California; Frederic A. Delano, chairman of the National Resources Planning Board; Harland Bartholomew, city planner, St. Louis; and Rexford G. Tugwell, then chairman of the New York City Planning Commission. It was instructed to assist the Federal Works Administrator in formulating a postwar program of interregional highway construction.

Worthy of note is the fact that this committee's report gives no space to the question of building any part of the proposed interregional system as toll superhighways although it is probable that the committee was appointed as a result of the renewed activities of the advocates of such toll roads. The report adheres to the principles laid down by the Public Roads Administration in 1939 in its report "Toll Roads and Free Roads." That report asserted that a system of transcontinental toll highways was not feasible and recommended to Congress the formation of a system of free interregional highways through the modernization of the necessary parts of the federal-aid system (*ENR* May 11, 1939, p. 655).

Significant in connection with the question of toll highways is the fact that the interregional system as proposed by the committee does not include the Pennsylvania Turnpike, which is a toll highway.

New study authorized

In July of last year Congress directed Commissioner MacDonald to make a study of the need for a system of express highways throughout the United States, the number required and the approximate routes and cost. The current report, the President stated in transmitting it to Congress, should be considered as complying with that directive from Congress. The President added that early action in authorizing joint designation by the federal government and the several state highway departments of a national system of interregional highways is desirable in order to facilitate the acquisition of land.

Special study was made of three interregional systems of different mileages—one of 48,400 miles, one of 36,000 miles, and one of 33,920 miles. In selecting these system routes the objective in each case was: "To incorporate within each of the several mileage limits adopted, those principal highway routes which would reach all sections of the country; form within themselves a complete network, and jointly attract and adequately serve a greater traffic volume than any other system of equal extent and condition." These systems were compared with each other and also with other systems previously considered by the Public Roads Administration, and selection settled upon the 33,920-mile system.

Location for service

The 33,920-mi. system connects directly all cities of 300,000 or greater population; it reaches 59 of the 62 cities having populations of 100,000 to 300,000, 62 of 107 cities of 50,000 to 100,000 population, 121 of 213 cities of 25,000 to 50,000 population and 295 of 665 cities having a population of 1,000 to 25,000. Commenting on these figures the report says: "Any effort to reach a larger number of cities under 50,000 population than are connected by the recommended system, it is believed must result in a lowering of the average traffic volume served by the system as a whole." Further, in respect to population served, the report states that while the 33,920-mi. system directly connects only 54½ percent of all cities of 10,000 or more population the population of these cities is 82.6 percent of the total urban population of

the nation. Again while the system routes traverse only 34.3 percent of the counties of the United States these counties have 45.2 percent of the rural population of the nation.

The cities of 10,000 or greater population connected by the 33,920-mi. system are in general the more important manufacturing cities. Numerically only 54½ percent of all such cities, they account for 82 percent of the total value added by manufacture in all. The counties traversed by the system routes account for 43.3 percent of the total value of all farm products sold or traded in the nation as a whole. In the cities connected and in the counties traversed, also, is centered 68.7 percent of the motor car ownership of the country as of 1941.

Right-of-way reforms

The report lays stress on reforms needed in laws and processes for acquiring highway rights-of-way. "The greatest single impediment," it says, "to the timely realization of desirable road improvement has been the difficulty of acquiring the necessary rights-of-way." The causes are: (1) Failure to plan and provide funds sufficiently in advance of construction, and (2) cumbersome and time-consuming land acquisition processes required by the laws of most states.

These views were endorsed by Brig. Gen. Philip B. Fleming, Administrator, Public Works Agency, who said in transmitting the report to the President:

"The recent act of Congress (Public Law No. 146—78th Congress) provides for payment of the federal share of the right-of-way costs of postwar projects only after construction has been actually begun. The states are required to advance from their currently reduced revenues, for the period of the war, the whole cost of rights-of-way acquired. Their inability to do this in many cases means that essential rights-of-way will be lacking when construction should be started, and the purpose of the wise provision that has been made for advance planning will thus be in large measure defeated. Moreover this right-of-way obstacle is likely to be most serious in the case of the very important projects that are being designed to relieve traffic congestion in cities, projects that will afford, if they are ready, large employment in the precise places where the need of employment will be greatest.

"To remedy this unfortunate defeat in the preparatory measures that have been taken, I strongly recommend Congressional action to permit the federal government to pay promptly its proportionate share of the costs of rights-of-way acquired in anticipation of postwar highway improvements."

The report points out that a complete remedy for right-of-way acquisition delays will require revision of legally established methods in many states. In 55 jurisdictions examined it was found that 320 such methods were in use, "with nothing inherent either in the nature of the governmental units exercising the power or in the public uses for which the lands are acquired to require such varied treatment."

Adequate widths of rights-of-way are stressed. The minimum required for urban sections will generally be at least as great as the depth of city property lots. In most cases, however, a fully adequate provision for city sections will require the acquisition of block-wide strips. For rural

Fig. 1. The general location of the routes proposed for the 33,920-mile interregional highway system are shown on this map. Final locations in most instances will not be made until fuller studies can be carried to conclusion.

sections, especially of two-lane roads, the width acquired should provide for any surface widening that may be reasonably anticipated. In addition the width should provide for a marginal strip on each side to prevent close crowding structures.

Roadway design

Extensive basic instructions are given for roadway design. The construction-controlling requirements are briefly as follows:

1. Facilities to serve a mixed traffic of passenger cars, busses, trucks and tractor-trailer and semitrailer combinations estimated as of 20 years after construction.

2. Roadway and structures to provide for (in number and frequency as estimated for 20 years after construction) vehicles of the following dimensions and weights: Width 60 in.; height 12½ ft.; lengths, single vehicles 35 ft., tractor semitrailer combinations 50 ft. and other combinations 60 ft.; weights according to the formula. $W = C\ (L + 40)$ in which W is gross weight in pounds, L is the length between forward and rear axles and C is a coefficient 650 for L less than 18 ft., and 750 for L greater than 18 ft.

3. Sections in or approaching cities and at least one mile long, when intersections are ¼ mi. or less apart, are to be considered as urban sections regardless of official city limits.

4. Rural sections to be designed for safe travel for speeds not less than as follows: In flat topography, passenger cars 75 mi., and trucks 60 mi.; in rough terrains, passenger cars 55 mi. and trucks 35 mi. For urban sections the design is to be for passenger car speeds of 50 mi. and truck speeds of 35 mi.

Allotment of costs

No estimate of total cost is attempted. It is estimated that roads carrying up to 1,000 vehicles a day, about 21 percent of the rural mileage of the system, will cost from $40,000 to $60,000 a mile, and roads carrying from 1,000 to 2,000 vehicles a day, about 29 percent of the rural mileage of the system, will cost from $50,000 to $70,000 a mile. For roads of 2,000- to 3,000-vehicle traffic the estimates are indefinite. Under the most favorable conditions the cost would probably be little greater than for roads in the 1,000-to-2,000-vehicle class. Where extensive four-lane construction is required and on sections serving traffic approaching the upper limit of the range, the cost might closely approximate that of complete four-lane construction. This construction as proposed for a 3,000- to 15,000-vehicle range (about 30 percent of the system mileage) would probably cost from $100,000 to $700,000 a mile.

The previous figures relate to the rural mileage of the system. For urban roads, the report says, to give costs in relation to traffic volume is unpracticable.

Division of costs

In respect to the division of road costs between states and nation the report considers the following recommendation to be vital:

In spite of the recognized needs for highway improvement and notwithstanding the widespread need for employment, local expenditures for highways, both for construction and maintenance, were reduced during the depression by amounts at least equal to the increases in federal expenditure, so that the employment purposes of the federal government were largely or completely nullified.

To forestall a similar defeat of any postwar effort of the federal government to provide, through highway construction, for increased employment, the committee recommends a return to the tested principles of the Federal Highway Act which require (1) the federal contribution to construction to be matched in substantially equal amount by the states, and (2) the states to maintain the highways built with federal assistance. Whatever may be the cooperating governments, whether state, county, or city, the committee recommends the application of these principles in fixing the amount of the federal and local contributions.

Rates of expenditure

On the basis of a national annual income of 100 billion dollars the report considers 15 billion dollars as reasonable and desirable for all classes of construction and maintenance, public and private. Reasoning from the figures of past construction it is estimated that the requirement of private construction will not reach an average of 8 billion dollars a year. Of the 7-billion dollars remaining for public construction a reasonable estimate, based on past records, is one-half or 3½ billion dollars for public roads construction and maintenance.

Assuming a minimum of 3 billion dollars and deducting $750,000,000 for maintenance, there remains 2¼ billion dollars for construction.

As the interregional highway system is designed to serve 20 percent of the total street and highway traffic of the nation, the report states that this would indicate that 20 percent of the 2.25 billion dollars for highway construction, or 450 million dollars per year, should be spent on that system. The committee believes, however, that this should be raised to 30 percent (675 million dollars) or to 750 million dollars because of the greater road-use-tax revenue that the system will stimulate.

With due regard to the needs of improvement within and without the interregional system, it is the committee's opinion that expenditures in the immediate postwar years at the rate of $500,000,000 per year on urban sections and $250,000,000 a year on rural sections are necessary and can be achieved without jeopardy to the essential improvement of other parts of the entire road and street system.

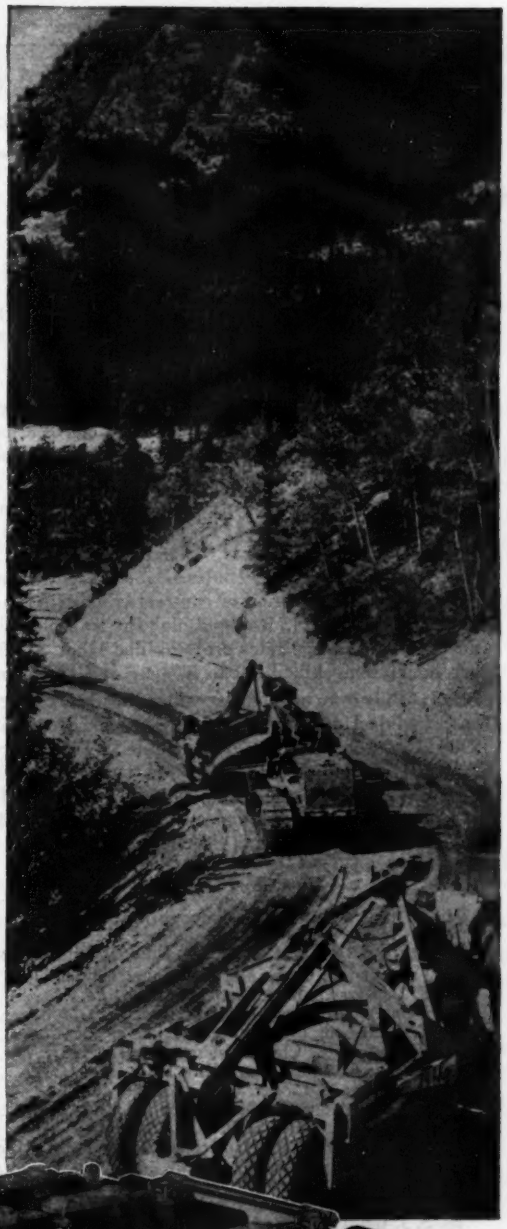
Employment created

Using records of highway construction employment accumulated by the Public Roads Administration it is estimated that highway construction will furnish 19,350 man-years of direct and 43,120 man-years of indirect employment for each $100,000,000 expended annually. Under the same conditions highway maintenance may be expected to provide 54,500 man-years of direct and 26,550 man-years of indirect employment for each $100,000,000 expended annually. On the basis of these estimates, the total highway program of 3 billion dollars, consisting of $2,250,000,000 for construction and $750,000,000 for maintenance, indicated previously as the probable essential postwar program, will afford 840,000 man-years of direct employment and 1,160,000 man-years of indirect employment. Of these totals, the interregional system constructed at the recommended rate, corresponding to an annual expenditure of $750,000,000, would employ each year 145,100 man-years directly and 323,400 man-years indirectly, or a total of 468,500 man-years per year.

The Alcan Highway was not child's play

Exide Batteries are specifically designed to crank a Diesel Engine under *all* conditions. On the Alcan Highway, the "short route to Tokio," operation of "off-the-highway" equipment was required many times at 55° below zero. Not only did they have to plow through some of the roughest, muddiest country on this continent but, very often, had to buck snow drifts up to 5 and 6 feet deep. The fact that the road went through away ahead of schedule is a tribute to the men on the job and the equipment they used.

Many of the bulldozers, tractors, and trucks used on this wartime project were equipped with Exide Batteries. Their extreme dependability, long-life, and ease of maintenance contributed much to efficiency and speed of that equipment. There is no question about the superiority of Exides. Hot or cold, rain or shine . . . Exides pack tremendous reserve power at high voltages. When you buy an Exide, you *Buy to Last.* Take care of it and *Save to Win.*



BUY TO LAST
SAVE TO WIN

Follow these four simple rules for battery care

1 Keep adding approved water at regular intervals. Most local water is safe. Ask us if yours is safe.

2 Keep the top of the battery and battery container clean and dry at all times. This will insure maximum protection of the inner parts.

3 Keep the battery fully charged —but avoid excessive overcharge. A storage battery will last longer when charged at its proper voltage.

4 Record water additions, voltage, and gravity readings. Don't trust your memory. Write down a complete record of your battery's life history. Compare readings.

If you wish more detailed information, or have a special battery maintenance problem, don't hesitate to write us. We want you to get the long-life built into every Exide. Ask for booklet Form 2399.

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BATTERIES
FOR CRANKING
DIESEL ENGINES

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 32
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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

AIRPORT CONSTRUCTION
MARTINSBURG, W. VA.

OWNER: Civil Aeronautics Admin., First Region, LaGuardia Field, N. Y.

PROJECT: Construction of two runways 5,000-ft. by 150-ft. and taxiways 2,000-ft. by 50-ft., together with the necessary apron, including grading, draining and paving. Work is located at the Martinsburg Municipal Airport in Berkeley County, about four miles southwest of Martinsburg, W. Va. Bids were asked on both bituminous and concrete paving for airport. Results of bidding on both types of pavement are shown in the tabulation below.

CONDITIONS: Contractor to furnish all materials with the exception of 100 feet of 24-in. pipe which is to be removed from existing line and relaid. Time for completion: Schedule I, 150 calendar days; Schedules II and III, 60 calendar days. Notice to begin operation of contract is expected to be given in the spring of 1944. Rail and highway transportation facilities available. Wage rates are: skilled labor, $1.00 to $1.50 per hour; semi-skilled, 80 to 87½c.; and common, 66c.

BIDS: Bids were opened December 15, 1943. Nineteen bids on Schedule I, Preparation of Site, ranged from $524,465 to $988,975; twenty-five bids on Schedule II, Paving (concrete), ranged from $409,100 to $596,500; and twenty-one bids on Schedule III, Paving (bituminous), ranged from $414,724 to $784,660. Engineer's estimates were: Schedule I, $655,281; Schedule II, $477,500; and Schedule III, $491,890. Contract not yet awarded.

Schedule I—Preparation of Site

LIST OF BIDDERS: Completion time, 150 Calendar days.

1. Lane Constr. Corp., Meriden, Conn. (low bidder) . . $524,465
2. F. D. Kessler, Inc., Northumberland, Pa. 624,450
3. John Arborio, Inc., Poughkeepsie, N. Y. 626,490
4. C. W. Good, Inc., Lancaster, Pa. 637,271
5. Walker Bros., Chambersburg, Pa. 637,652
6. Larkins Co., Inc., Camp Hill, Pa. 660,588
7. Bero Engr. & Constr. Corp., Buffalo, N. Y. 697,510
8. The Grandview Co., Mt. Vernon, N. Y. 698,596
9. F. D. Cline, Raleigh, N. C. 699,773
10. Peter Mitchell, Inc., and Paul Bacco & Son, Inc., Greenwich, Conn. 702,040
11. F. S. Tillman, Dayton, Ohio 703,169
12. Frank Stento & Son, Binghamton, N. Y. 852,741
13. S. J. Groves & Sons Co., Ridgefield, N. J. 875,126
14. Del Balso Contsr. Corp., New York, N. Y. 891,630
15. Rusciano & Son Corp., Bronx, N. Y. 892,294
16. Potts & Callahan Contract. Co., Inc., Baltimore, Md. . 893,281
17. Central Pennsylvania Quarry, Stripping & Constr. Co., Hazleton, Pa. 938,538
18. Reiss & Weinsier, Inc., Brooklyn, N. Y. and Tufano Contr'g. Corp., Jamaica, N. Y. 940,683
19. John B. Schultz Contr'g. Co., Inc., Buffalo, N. Y. . . . 988,975

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	Lump Sum	$15,000.00	$5,000.00	$10,000.00
2. Clear and grub, if ordered	2 ac.	400.00	400.00	200.00
3. Clearing	5 ac.	200.00	200.00	200.00
4. Unclassified excavation	700,000 c. y.	.53	.70	.61
5. 8-in. drainage pipe, open joint	7,600 l. f.	.70	.50	.70
6. 10-in. drainage pipe, open joint	4,600 l. f.	.90	.60	.85
7. 12-in. drainage pipe, open joint	5,300 l. f.	.95	1.00	1.05
8. 18-in. drainage pipe, open joint	3,400 l. f.	1.25	1.25	1.30
9. 18-in. drainage pipe, open joint	2,700 l. f.	1.65	2.00	1.50
10. 21-in. drainage pipe, open joint	1,450 l. f.	2.00	2.50	2.00
11. Excavation for drainage	6,000 c. y.	4.00	2.00	5.00
12. Compacted earth backfill	500 c. y.	4.00	3.00	2.00
13. Porous backfill	5,500 c. y.	5.00	4.00	5.00
14. 8-in. drainage pipe, sealed joint	1,700 l. f.	.80	.50	.80
15. 12-in. drainage pipe, sealed joint	1,250 l. f.	1.25	1.00	1.50
16. 12-in. encased pipe, sealed joint	100 l. f.	5.00	6.00	10.00
17. 15-in. drainage pipe, sealed joint	950 l. f.	1.75	1.35	2.20
18. 15-in. encased pipe, sealed joint	600 l. f.	5.50	6.50	12.00
19. 18-in. drainage pipe, sealed joint	310 l. f.	2.25	2.25	3.00
20. 18-in. encased pipe, sealed joint	60 l. f.	6.50	8.00	20.00
21. 21-in. drainage pipe, sealed joint	360 l. f.	3.00	3.00	3.20
22. 24-in. drainage pipe, sealed joint	210 l. f.	3.75	3.50	3.70
23. 30-in. drainage pipe, sealed joint	500 l. f.	5.00	5.00	6.00
24. 36-in. drainage pipe, sealed joint	780 l. f.	7.50	8.00	7.00
25. Unclassified excav. for drainage	2,800 c. y.	4.00	3.00	5.00
26. Remove, relay exist. 24-in. pipe	100 l. f.	1.75	3.00	5.00
27. Uncl. excav. for removing, relaying pipe	50 c. y.	4.00	2.00	6.00
28. Pipe spillway	300 l. f.	2.50	5.00	10.00
29. Manhole, solid covers	14 ea.	150.00	200.00	300.00
30. Manhole, grate covers	71 ea.	150.00	150.00	200.00
31. Catchbasins	85 ea.	65.00	150.00	178.00
32. Concrete for headwalls	50 c. y.	27.00	30.00	50.00
33. Change elevation, catchbasins	2 ea.	30.00	50.00	250.00
34. Excavation for french drains	50 c. y.	4.00	3.00	5.00
35. Porous backfill, french drains	50 c. y.	5.00	3.00	5.00
36. Grouted stone riprap	500 s. y.	2.25	3.00	6.00
37. Sodding for berm protection	2,500 s. y.	1.00	1.00	1.20
38. 3-in. fiber underground ducts	2,500 l. f.	.50	2.00	1.00

Schedule II—Airport Paving (concrete)

LIST OF BIDDERS: Completion time, 60 calendar days.

1. Lane Construction Corp., Meriden, Conn. (low bidder). (Only in combination with Schedule I) . . $409,100
2. Union Paving Co., Philadelphia, Pa. 422,200
3. Peter Mitchell, Inc., and Paul Bacco & Son, Inc., Greenwich, Conn. 423,500
4. DuBois Constr. Corp., New York, N. Y. 428,670
5. Larkins Co., Inc., Camp Hill, Pa. 443,300
6. Walker Brothers, Chambersburg, Pa. 450,760
7. F. D. Cline, Raleigh, N. C. 447,400
8. W. H. Armstrong Co., Inc., Washington, D. C. 448,950
9. Lane Construction Corp., Meriden, Conn. (Schedule II only) 452,300
10. S. J. Groves & Sons Co., Ridgefield, N. J. 469,000
11. L. G. DeFelice & Son, Inc., North Haven, Conn. 472,600
12. Reiss & Weinsier, Inc., Brooklyn, N. Y., and Tufano Contracting Corp., Jamaica, N. Y. 484,950
13. D. V. Frione & Co., Inc., New Haven, Conn. 485,200
14. Rusciano & Son Corp., Bronx, N. Y. 490,100
15. F. D. Kessler, Inc., Northumberland, Pa. 495,500
16. Potts & Callahan Contracting Co., Inc., Baltimore, Md. 495,500
17. John B. Schultz Contracting Co., Inc., Buffalo, N. Y. 495,600
18. F. S. Tillman, Dayton, Ohio 500,900
19. Seaboard Constr. Corp., Philadelphia, Pa. 501,900
20. Bero Engr. & Constr. Corp., Buffalo, N. Y. 513,825
21. John Arborio, Inc., Poughkeepsie, N. Y. 522,500
22. Union Building & Constr. Corp., Passaic, N. J. 528,350
23. Robert W. Cleveland & Co., East Orange, N. J. 536,900
24. The Grandview Co., Mt. Vernon, N. Y. 537,900
25. John M. Francesa, Charleston, W. Va. 596,500

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Unclassified excavation	500 c. y.	$1.00	$2.00	$1.00
2. 8-in. concrete paving, Class A	180,000 s. y.	2.27	2.34	2.20

Schedule III—Airport Paving (bituminous)

LIST OF BIDDERS: Completion time, 60 calendar days.

1. Lane Constr. Corp., Meriden, Conn. (low bidder). (Only in combination with Schedule I) $414,724
2. Bero Engr. & Constr. Corp., Buffalo, N. Y. 429,250
3. Larkins Co., Inc., Camp Hill, Pa. 434,445
4. Walker Brothers, Chambersburg, Pa. 449,100
5. Peter Mitchell, Inc., and Paul Bacco & Son, Inc., Greenwich, Conn. 450,333
6. Lane Constr. Corp., Meriden, Conn. (Schedule III only) 456,674
7. Potts & Callahan Contr. Co., Inc., Baltimore, Md. 461,350
8. Del Balso Constr. Corp., New York, N. Y. 462,965
9. R. B. Tyler Co., Monroe, N. Y. 463,340
10. F. D. Cline, Raleigh, N. C. 467,921
11. Robert W. Cleveland & Co., East Orange, N. J. 489,310

SPEED TOMORROW'S HIGHWAYS

'Incor's War Record Points Way to Time-Saving Economy

NOTHING less than all-out speed in making up the war-enforced, highway-mileage deficit will save the nation from a serious case of post-war hardening of the highway arteries. 'Incor' 24-Hour Cement can help solve this problem—dependable high early strength which rushed America's war plants to completion, can provide the same two-fold advantage of speed and economy in meeting this highway need. Use 'Incor' at critical points—intersections, bottlenecks, cloverleafs, bridges. Earlier use saves costly detours—long-time durability saves maintenance cost through the years.

Forward-looking Louisiana built Nesser-Mississippi River Bridge Highway to carry South's heaviest traffic around Baton Rouge. Planned for maximum advantage, both to motorists and taxpayers, T. L. James & Co., Inc., Ruston, La., used 'Incor'* at key intersections, saving 12 days' traffic-hazard detouring around "green" concrete. In all other paving, Lone Star Cement was used. Selective use of these two high quality Portland cements points the way to progress.

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LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 15 MODERN MILLS, 25-MILLION BARRELS ANNUAL CAPACITY

12. Standard Bitulithic Co., New York, N. Y. 489,734
13. John B. Schultz Contr. Co., Inc., Buffalo, N. Y. 500,995
14. Murphy Constr. Co., Morgantown, W. Va. 512,700
15. Allegheny Asphalt & Paving Co., Pittsburgh, Pa. .. 524,350
16. Union Building & Constr. Corp., Passaic, N. J. 526,636
17. F. D. Kessler, Inc., Northumberland, Pa. 528,790
18. Union Paving Co., Philadelphia, Pa. 531,053
19. John M. Francesa, Charleston, W. Va. 583,780
20. Reiss & Weinsier, Inc., Brooklyn, N. Y., and Tufano Contr. Corp., Jamaica, N. Y. 644,720
21. John Arborio, Inc., Poughkeepsie, N. Y. 784,660

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Unclassified excavation	500 c. y.	$1.00	$1.65	$1.00
2. 8-in. conc. pavement, parking area	3,500 s. y.	3.50	3.20	3.60
3. Emulsified asphalt, 2-in. base crse	400,000 gal.	.10	.12	.12
4. Coarse aggregate, 2-in. base crse	20,000 ton	2.30	2.35	2.34
5. Choke aggregate, 3-in. base crse	2,500 ton	3.50	3.25	2.38
6. Key stone, 3-in. base crse	3,100 ton	3.50	3.25	2.41
7. Coarse aggregate, dry bnd. mac. base crse	61,000 ton	2.22	2.30	2.41
8. Screenings, dry bnd. mac. base crse	23,000 ton	2.40	2.35	2.38
9. Aggregate, 1½-in. surf. crse	12,800 ton	4.30	4.50	4.34
10. Bituminous mat'l., surf. crse	900 ton	19.30	20.25	20.25
11. Aggregate, 3-in. surf. crse	4,600 ton	4.30	4.50	4.34
12. Bituminous mat'l., 3-in. surf. crse	280 ton	19.30	20.25	20.25
13. Bitum. mat'l., seal coat	36,000 gal.	.10	.12	.14
14. Cover aggregate, seal coat	1,300 ton	4.50	3.50	3.25

INTERCEPTING SEWER, CLEVELAND

OWNER: City of Cleveland, J. C. Wenrick, city engineer.

PROJECT: Reconstruction of Big Creek intercepting sewer from Jennings Road, S.W., to Cuyahoga River in Cleveland, Ohio. Involves clearing site, necessary excavation, construction of circular brick sewer and appurtenances; and retaining wall. Four alternates were allowed as follows: (A) Reconstruction of existing pipe (paved invert) and concrete retaining wall; (B) Reconstruction of existing pipe (paved invert) and metal bin-type retaining wall; (C) New 60-in. metal pipe (lined) and concrete retaining wall; (D) New 60-in. metal pipe (lined) and metal bin-type retaining wall. Contract awarded on basis of Alternate C.

CONDITIONS: Contractor to furnish all materials. Rail, highway and water transportation facilities available. Cleveland wage rates are: skilled labor, $1.55 to $1.875 per hour; and common labor, $1.00 to $1.25.

BIDS: Five bids were received December 2, 1943, ranging from the contract low of $38,563 to $54,990.

LIST OF BIDDERS: (Alternate C, new pipe and concrete wall)

1. Domenic Nero Constr. Co., Cleveland, Ohio (contract) $38,563
2. National Engr. & Contracting Co., Cleveland, Ohio 38,591
3. National Construction Co., Cleveland, Ohio 41,235
4. D. M. Sylvester & P. DiPaolo Constr. Co., Cleveland, Ohio 56,400
5. Lake City Constr. Co., Cleveland, Ohio 54,990

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing the site	Lump Sum	$1,000.00	$1,200.00	$1,200.00
2. Excavation of site	100 c. y.	5.00	12.00	10.00
3. 6' 3" circular brick "E" sewer, squared-out bottom	70 l. f.	55.00	64.00	70.00
4. 4-ft. cir. brick "C" sewer	35 l. f.	35.00	24.00	35.00
5. 4-ft. cir. brick "E" sewer, squared-out bottom	10 l. f.	43.00	40.00	45.00
6. 4-ft. cir. brick "C" sewer, squared-out bottom	35 l. f.	38.00	24.00	40.00
7. Circular "E" brick reducer, squared-out bottom, 6' 3" to 5'	6 l. f.	65.00	70.00	70.00
8. Circular "C" brick increaser, 5' to 6' 3"	6 l. f.	50.00	60.00	50.00
9. Emergency outlet chamber	1 ea.	1,400.00	1,250.00	1,500.00
10. Drop manhole, complete	1 ea.	800.00	1,150.00	750.00
11. Manhole on 6' 3" brick sewer	1 ea.	65.00	125.00	100.00
12. Headwall on 4' brick sewer, complete, incl. apron	25 c. y.	35.00	25.00	30.00
13. Granulated slag fill, in place	1,400 c. y.	3.00	3.75	4.50
14. Connect 6' 3" brick sewer to existing sewer	2 ea.	100.00	50.00	50.00
15. Additional fill	20 c. y.	5.00	3.50	10.00
16. Two conc. piers, complete as specified	14 c. y.	60.00	40.00	70.00
17. Struct. steel reconstruction	4 ton	100.00	100.00	50.00
18. Two headwalls on 6' 3" sewer	18 c. y.	45.00	32.00	40.00

Metal Bin-Type Retaining Wall Alternate (no award)

Item	Quan.	Unit Prices (1)	(2)	(3)
19. Metal bin-type retaining wall	300 s. f.	$7.67	$7.00	$12.00
20. Excavation and fill (bin-type)	50 c. y.	3.50	4.00	6.00
21. Additional backfill (bin-type)	70 c. y.	3.50	4.00	10.00

Concrete Retaining Wall Alternate (award)

Item	Quan.	Unit Prices (1)	(2)	(3)
22. Concrete retaining wall	45 c. y.	$40.00	$27.00	$70.00
23. Excavation and fill (conc. wall)	55 c. y.	3.50	5.00	10.00
24. Additional backfill (conc. wall)	20 c. y.	3.50	4.00	10.00
25. Gran. slag backfill (conc. wall)	10 c. y.	3.00	5.00	10.00

Reconstructing Existing Pipe Alternate (no award)

Item	Quan.	Unit Prices (1)	(2)	(3)
26. Reconstruct exist. wr. iron pipe with paved invert (Trestle No. 1)	Lump Sum	$12,850.00	$13,375.00	$13,000.00
27. As above, at Trestle No. 2	Lump Sum	12,912.00	12,750.00	12,300.00

New 60-in. Metal Pipe Alternate (award)

Item	Quan.	Unit Prices (1)	(2)	(3)
28. New 60-in. metal pipe (lined) at Trestle No. 1	142 l. f.	$53.00	$54.00	$44.00
29. New 60-in. metal pipe (lined) at Trestle No. 2	193 l. f.	53.00	49.00	46.00

HIGHWAY AND BRIDGE, VIRGINIA

OWNER: Virginia Department of Highways, Richmond.

PROJECT: Construction of 2.457 miles of waterbound macadam mixed in place cold bituminous surface treatment, from intersection of State Route 211 (near Buckland) to point 2.457 miles south of intersection, on State Routes 295 and 652 in Fauquier County, Va. Also bridge over South Run from Sta. 87+26 to Sta. 87+74. Bridge is reinforced concrete; span on 30-deg. skew; length 48-ft.; roadway 26-ft. clear.

CONDITIONS: Contractor to furnish all materials and complete work in 120 calendar days. Highway transportation facilities available. Prevailing wages to be paid.

BIDS: Seven bids were received December 21, 1943, ranging from the contract low of $75,009 to $98,958.

LIST OF BIDDERS:

1. Blackwell Engr. & Constr. Co., Warrenton, Va. (contract) $75,009
2. Corson & Gruman, Washington, D. C. 79,750
3. Echols Bros., Inc., Staunton, Va. 79,772
4. Kent & Co., Richmond, Va. 81,012
5. M. S. Hudgins, Roanoke, Va. 89,425
6. Pendleton Constr. Corp., Wytheville, Va. 97,899
7. W. W. Sanders, Warrenton, Va. 98,958

Roadway

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	1 ac.	$300.00	$250.00	$200.00
2. Regular excavation	27,302 c. y.	.42	.55	.45
3. Concrete, Class C	13 c. y.	32.00	30.00	22.00
4. 6-in. pipe underdrains	300 l. f.	1.15	.80	1.00
5. Subgrade underdrains, CD-1 or CD-2	770 l. f.	.50	.70	.75
6. 15-in. concrete pipe	450 l. f.	1.75	2.00	2.25
7. 18-in. pipe	144 l. f.	2.00	2.25	3.00
8. 12-in. pipe	18 l. f.	1.70	1.75	1.50
9. Project markers, Federal-Aid	2 ea.	5.00	10.00	5.00
10. State project marker	1 ea.	5.00	5.00	5.00
11. No. 13 stone for subgrade treatment	1,498 ton	1.75	2.60	2.50
12. No. 13 stone for entrances	4 ton	3.00	3.00	2.50
13. Plain concrete curb	358 l. f.	1.25	1.00	1.25
14. Scarifying and reshaping	11,173 s. y.	.07	.15	.12
15. Waterbound macadam, 22-ft. by 8-in.	12,636 s. y.	1.40	1.25	1.60
16. Widening, 8-in. waterbound macad	7,517 s. y.	1.60	1.35	1.80
17. Bituminous material (RC-2)	42,278 gal.	.12	.14	.12
18. Covering material	1,586 ton	4.75	5.00	3.75
19. Bonding material, No. 13 stone	272 ton	2.50	2.60	2.50

Bridge

Items	Quan.	Unit Prices (1)	(2)	(3)
20. Class A concrete, superstr.	77.9 c. y.	$32.00	$35.00	$38.00
21. Reinforcing steel, superstr.	21,700 lb.	.06	.06	.06
22. Class B conc., substructure	332.2 c. y.	26.00	23.00	20.00
23. Cl. A excavation, substructure	175 c. y.	3.00	2.00	2.00
24. Cl. B. excavation, substructure	146 c. y.	6.00	3.00	6.00

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Both plants are without windows — blacked out permanently so more than 30,000 workers can continue at top speed night and day under high level fluorescent lighting. Automatically-controlled temperatures and ventilation help maintain high efficiency the year around.

These huge North American Aviation plants are another example of Turnbull engineering skill and construction "know-how" that assure maximum production in the shortest possible construction time. Whether you plan on new, modernization or conversion projects, a discussion of Turnbull engineering advantages will be of vital interest to you.

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FLA.... Jacksonville & Miami—Florida Equipment Co.
Tampa—Orange State Motor Co.
Pensacola—Ray-Brooks Truck & Tractor Company
GA..... Atlanta—Tri-State Culvert & Machinery Co.
IDA.... Boise & Pocatello—Intermountain Equipment Co.
ILL..... Peoria & Springfield—A. E. Hudson Company
Salem—E. W. Werner Motor Company
Chicago—Great Lakes Supply Corp.
IND.... Indianapolis—J. D. Adams Company
Newburgh—Matt W. Foster
IOWA... Des Moines—Herman M. Brown Company
KANS... Wichita—S. H. Denney Road Machinery Co.
KY..... Louisville—Brandeis Machinery & Supply Co.
LA..... Baton Rouge—Dunham-Pugh Company
MAINE.. Portland—Maine Truck-Tractor Co.
MD.... Baltimore—Paving Supply & Equipment Co.
MASS... Newton Highlands—Tractors, Inc.
MICH... Bark River—Bark River Culvert & Equipment Co.
Detroit and Grand Rapids—
Wolverine Tractor & Equipment Co.
MINN... Minneapolis & Duluth—Thorman W. Rosholt Co.
MISS... Jackson—Mississippi Road Supply Co.
MO.... St. Louis—Missouri-Illinois Tractor & Equip. Co.
Kansas City—Noel V. Wood, Inc.
MONT.. Billings—Industrial Equipment Company
NEB.... Omaha—Nebraska Tractor & Equipment Company
NEV.... Reno—Allied Equipment, Inc.
N. H.... Chester—R. C. Hazelton Co.
N. J.... Trenton—Ross, Young, Ditts Corp.
N.M.... Albuquerque—Hardin & Coggins
N. Y.... Groton—Clapp Machinery Company
Buffalo—Dow & Company, Inc.
Brooklyn—Edward Ehrbar, Inc.
Long Island—George Malvese & Co.
Albany—Slade Tractor Co., Inc.
N. C.... Raleigh—J. B. Hunt & Sons
N. D.... Fargo—Myhra Equipment Company
OHIO... Cleveland—Gibson-Stewart Company
Cincinnati—H. P. Kelly Equipment Co.
Cambridge—C. E. Major
OKLA... Tulsa & Guthrie—C. L. Boyd Company, Inc.
ORE.... Portland & Eugene—Howard-Cooper Corporation
PA..... Butler—National Culvert & Equipment Co.
Pittsburgh—Brinker Supply Company
Philadelphia—Service Supply Corp.
Camp Hill—L. B. Smith, Inc.
R. I.... Providence—Tractors, Inc.
S. C.... Columbia—N. H. Summers Road Machinery Co.
S. D.... Sioux Falls—Empire Equipment Company
TENN... Knoxville & Chattanooga—
Brooks Equipment & Mfg. Co.
Nashville—Industrial Tractor & Equipment Co., Inc.
Memphis—Road Builders Equipment Co.
TEXAS.. Dallas & Houston—Crowning-Ferris Machinery Co.
San Antonio—Jess McNeel Machinery Co.
Plainview—Plains Machinery Company
UTAH... Salt Lake City—The Lang Company
VT..... Montpelier—Vermont Road Equipment Co.
VA..... Richmond—Municipal Sales Company
Roanoke—Roanoke Tractor & Equipment Corp.
WASH... Spokane, Seattle, Walla Walla—
Howard-Cooper Corporation
W. VA.. Charleston—Charleston Tractor & Equipment Corp.
WIS.... Eau Claire—Bark River Culvert & Equipment Co.

SEE **Adams**
AD ON OPPOSITE PAGE

NEW AIDS TO THE CONSTRUCTOR

Underwater Cutting Torch

A wide cut, so desirable in underwater cutting, is possible with a new electric torch, it is claimed, which operates on a 300-amp. welding machine. No hydrogen is required to operate the torch, and it has been found that only a small amount of oxygen is necessary.

The torch is simple to operate, and its cutting efficiency is not affected by the depth of the water. It uses electrodes 12 in. long, made of brass tubing and cast iron rod. It will cut iron and brass, and the metal cut need not have a clean surface.—*Swafford & Hancock, Box 566, Batesville, Ark.*

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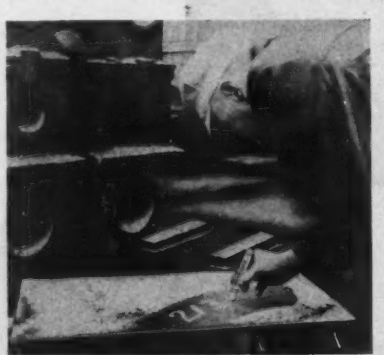
Paint Stick

Handy and clean as a pencil, the new Markal "B" paint stick is especially

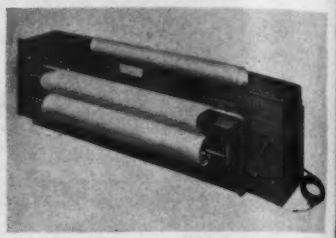


adapted to marking icy, wet or oily metal surfaces, it is claimed. This weatherproof paint stick is long lasting, and is made in a variety of colors for easy, permanent identification purposes and for piece work marking.—*Markal Co., 6 East Lake St., Chicago, Ill.*

• • •

Continuous Printers

Any convenient table or bench will serve as a base for two new compact, portable continuous printers, according to the manufacturer's announcement. These "B-1" and "B-2" models are said to produce clear blueprints or direct-process black and white prints up to 44 in. wide, in any lengths, at a speed of 42 in. per minute, and to cost only 1c. to 1½c. per sq.ft., including labor. The printers plug into any standard electric outlet, and the Cooper-Hewitt mercury



vapor tube lamps, mounted horizontally, give uniform overall light intensity. Clear, hand polished contact glass and sliding contact insure clear, clean exposure.

Both models—B-1 and B-2—are finished in olive-green wrinkle baked enamel, and are 16x16x62 in. The ball-bearing equipped, variable-speed drive provides a wide speed range, and no lubrication is required.—*Peck & Harvey, 4327 Addison St., Chicago, Ill.*

• • •

Powerful Generator

Believed to be the most powerful generator in the world for its size, the new EPCON portable generator B-30 delivers 3,000 watts, 110-volt AC, 60 cycle,

and weighs only 305 lb. It is 34 in. long, including the base, and 26 in. high.

The generator's field ring is high-grade annealed cast steel, and cast iron

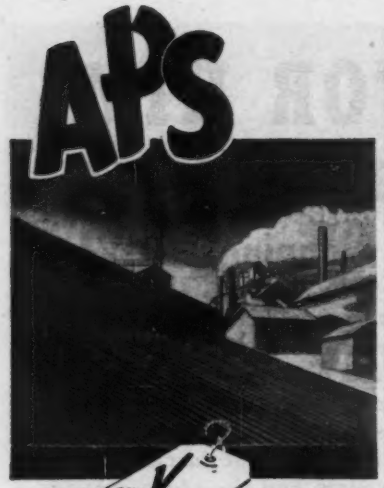
LET'S HAVE A JOB FOR HIM
WHEN HE COMES HOME
—through Post-War Planning *NOW!*

● While the war is far from being won—yet—the day is coming when millions of uniformed boys will be returning and they will need jobs. The thousands of highway and street improvement projects held up for two years and so badly needed can provide those jobs immediately at the close of the war *if* every state, county, and city administration will bring these projects up to the specification and blue print stage *now*.

Whether you are highway official or contractor, your post-war planning will not be complete without consideration of the many ways in which Adams equipment can be adapted profitably to your work. Your local Adams distributor will be glad to talk this over with you at any time.

J. D. ADAMS COMPANY, INDIANAPOLIS, IND.
Sales and Service Throughout the World

ADAMS ROAD-BUILDING AND EARTH-MOVING EQUIPMENT



Everywhere . . . throughout Industry . . . from coast to coast, APS Protected Steel Sheets have proven their superiority, withstanding the most severe weather conditions, as well as salt laden air, acid fumes and gasses. APS requires neither painting, finishing, nor other maintenance.

APS sheets are readily available, easy to install, a favorite with industrials, chemical plants, fisheries, storage houses, and every type of essential structure.

Write for technical data and information

9

PROTECTED STEEL PRODUCTS CO.

General Office and Plant, WASHINGTON, PA.

fittings secure both the generator and the Briggs & Stratton engine to the oak sled runners which serve as the base. End bells are of open design, like a wheel with spokes. Dust covers are of light-weight steel spinnings; generator pulleys of cast steel discs.—*Electrical Products Consolidated, Seattle, Wash.*

• • •

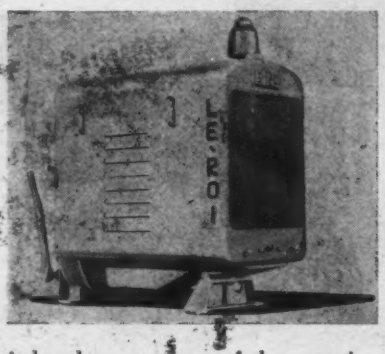
Welding Positioner Service

A complete service, covering design and construction of special welding positioners, has been announced. The Whiting welding positioner, it is said, facilitates downhand welding, saving both cost and operating time. No overhead cranes are tied up during the welding process. The positioner comes in sizes ranging from small hand-operated units to machines of over 20-ton capacity.—*Whiting Corp., Quickwork Division, Harvey, Ill.*

• • •

Heavy-Duty Engine

Built to give continuous service and long life, a new Model D140 four-cylinder valve-in-head engine has a piston displacement of 140 cu. in., and develops up to 33 hp. at 2,400 rpm. The valve-in-head arrangement and wet cyl-



inder sleeves are two of the more important features.

Model D140 has a drop forged, counterweighted crankshaft, large main bearings, vertical magneto, precision bearings, oil bath air cleaner, valve seat inserts, full pressure lubrication and conveniently located controls. Completely housed, the unit has smooth, modern contours.—*Le Roi Co., 1706 S. 68th St., Milwaukee, 14, Wis.*

• • •

Spring Hanger

Designed to minimize changes in pipe supporting force, it is believed that a new pre-engineered spring hanger will be a welcome device. After computing the load, a size of hanger may be selected from 14 stock sizes, for loads from 84 to 4,700 lbs.

Of all-steel welded construction, which meets the pressure piping code,

Here Is Your Nearest Worthington Distributor

For Sales, Rentals and Service on BLUE BRUTE Portable Compressors, Rock Drills and Air Tools.

See our full page ad on page 153

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ARIZONA
Phoenix — Smith Booth Usher Company
ARKANSAS—Fort Smith — R. A. Young & Son
Little Rock — R. A. Young & Son
CALIFORNIA
Los Angeles — Smith Booth Usher Company
San Francisco—Edward F. Hale Company
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ILLINOIS — Chicago — Kennedy-Cochran Co.
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Albany—T. Southworth Tractor & Machy. Co., Inc., Menands
Binghamton — MacDougall Equipment Co.
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Middleton — S. T. Randall, Inc.
New York—Hubbard & Floyd, Inc.
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Durham — Constructors Supply Company, Inc.
OHIO — Cincinnati — The Finn Equipment Company
Cleveland — Gibson-Stewart Company
Marietta — Northwest Supply & Equipment Co.
Toledo — M. W. Kilcorse & Company
OKLAHOMA
Oklahoma City — Townsco Equipment Co.
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Philadelphia — Metalweld, Inc.
Pittsburgh — John McC. Latimer Company
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Columbia — Bell-Lott Road Machinery Co.
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Chattanooga — James Supply Company
Knoxville—Wilson-Wessner-Wilkinson Co.
Memphis — Tri-State Equipment Company
TEXAS — Dallas — Shaw Equipment Company
El Paso — Equipment Supply Co.
Houston — Dye Welding Supply Co.
San Antonio — Patten Machinery Company
UTAH — Salt Lake City — The Lang Co.
VIRGINIA
Richmond — Highway Machinery & Supply Co.
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Seattle — Star Machinery Company
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Cheyenne — Wilson Equipment & Supply Co.

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Buy Blue Brutes

Worthington Pump and Machinery Corp.

To Cut Cost of $60,000,000 City Improvement

Behind the Fighting Fronts with BLUE BRUTES

Blue Brutes in wartime girdle the globe. Colored olive drab for Army, battleship gray for Navy, they speed the flight of Fortresses from jungle air fields, help keep shell-shocked roads in occupied territories open to military traffic, and help build cantonments in the Arctic. On the Alcan highway, in Australia, on the Mediterranean fronts — and in hundreds of Army camps, Navy yards, air bases and ordnance plants here at home — Blue Brutes help the men who fight for our future. Your nearest distributor is listed on page 152.

ou'll want to know now what Blue tes can do, because some day you'll idding on jobs like this one:

post-war development program Portland, Ore., involving three bridges, a complete new system "thruways", a $10,350,000 sewage osal plant, 6 grade school build-, railroad depot, etc . . . Expend-e: $60,000,000 in 2 years for con-ction alone.

every new compressor and air tool buy saves only a fraction of a cent foot, they'd still be worth big money obs like that.

Worthington Blue Brute compressors, the one shown here, cut costs because they're made for easier breathing. Impact-free Feather Valves* which give Blue Brutes the nearest mechanical approach to human breathing, have Nature's simple strength.

You'll find a model of Blue Brute for *any* compressed air construction job when this war's over. Portable or semi-portable. Diesel, gasolene or electric-driven. And Blue Brute Rock Drills and Air Tools, which use less air, will help you get more worth from air delivered.

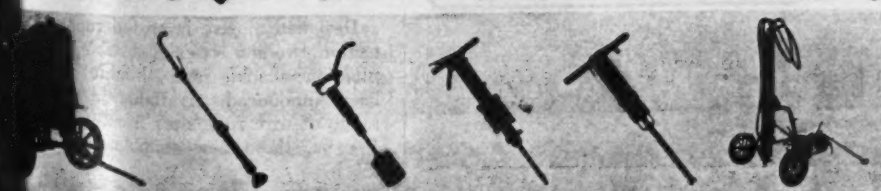
So, when you're figuring costs on that big job of tomorrow, bid with Blue Brutes in mind. They'll back the bid with what it takes to keep costs down. And that's your money's worth.

U. S. PAT. OFF.

PC 4-3

Get more WORTH from air with WORTHINGTON

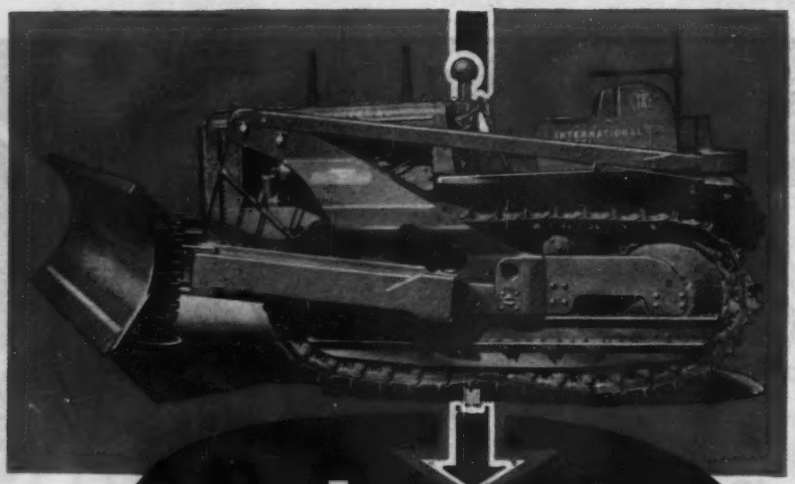
BUY BLUE BRUTES



essors from 60 to 500 cu. ft. capacity in mount-uit all jobs. Rock Drills and Air Tools that have always set the pace for easy operation — available in a wide range of weights and sizes.

WORTHINGTON

Worthington Pump and Machinery Corporation, Harrison, N. J. Holyoke Compresser and Air Tool Department, Holyoke, Massachusetts



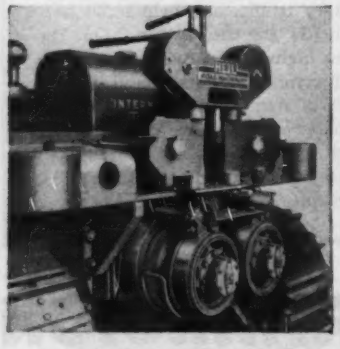
Balance

...assures ease of control and efficient operation

with the Heil Co.'s new

Cable Dozers

for International Harvester TracTracTors



Equipped with simple, fast-operating, troublefree Heil Cable Power Control Unit

Ample safety factor. Smooth-operating brake and clutch assemblies that eliminate shocks and jerks. Large drums that run cool. Sheaves designed to reduce wear on cables.

The full power of your tractor drives on the blade — moving more "pay dirt" with each load — and there is no nosing down or rearing up, because the center of gravity has not been changed by the addition of the Cable Dozer. This is just one example of the thorough engineering which has accomplished perfect teamwork all along the line. Note operator's unobstructed view — convenience of controls (adjustable to his reach) — rugged side member construction. Send for bulletin describing many other features which assure you of cleaner, faster dirt moving at lower cost. R-19

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ARMY-NAVY E

THE HEIL CO.

GENERAL OFFICES • MILWAUKEE 1, WISCONSIN

this spring hanger has a unique swivel coupling. Its compact design cuts required head room to a minimum, and its installation is simplified by integral load scale and travel indicator.—*Grinnell Co., Inc., Providence, R. I.*

• • •

Centrifugal Pumps

Supplied for use on the War Emergency Pipeline project known as the "20-Inch Products Line," which will parallel the famous "Big Inch," a new pump, Class 12BHVS, is a single-stage, centrifugal unit of horizontally split volute type. To save critical materials, all major castings are of high-grade cast iron.

Each pump is driven by a 1,500 hp. electric motor, at a rate of 3,570 rpm., and operates against a total head of 825

ft. The pump is so designed that two may operate in series (in which case the line will deliver about 83 percent of its rated capacity), or one may operate alone (55 percent of rated capacity). An extra-heavy shaft provides smooth operation, and the double-suction volute impeller is sealed by double impeller rings of shrouded type. Bearings are of self-aligning sleeve type, and deep stuffing boxes seal the shaft.—*Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.*

• • •

Flame Welders' Lenses

Made from a glass which absorbs sodium flare, a new lense enables flame welders to see working areas more clearly. In addition, this glass is said to protect eyes against both ultra-violet and infra-red radiation.

Ground and polished to ophthalmic standards, these lenses, in the new No. 3 shade, preserve orange and red color values so that the welders can see the red hot bead and the molten metal in brilliant colors.—*American Optical Co., Southbridge, Mass.*

• • •

Shackle-Thimble

Designed to give improved rope protection, two new styles of shimble (combination shackle and thimble) have been announced. Available in a full range of wire rope sizes from ⅛ in. to 1⅝ in., these new shimbles are hot

forged from mild steel bars, to provide rigid support for wire rope in correct, non-collapsible contour. It is claimed that the small area of rope-to-shimble

contact insures quick drainage and drying, which tends to eliminate corrosive action by salty moisture.

Regular pattern "Standard" (Standard shackle equivalent) and "Style A" (regular socket equivalent) are either painted or galvanized.—*Garlinghouse Bros., 2416 East 16th St., Los Angeles 21, Calif.*

• • •

New Plastic for Stress-Study Problems

Suitable for making three-dimensional models for photoelastic stress studies, a new plastic is said to cure in two days. It can be made in large pieces, and has already been produced in the laboratory in sheets measuring 600 in. square by 3 in. thick.

After the transparent plastic is stressed in a realistic manner, the stress lines show up as different colors when observed under polarized light. It is said that this material can be produced cheaply in large quantities, thus reducing stress-study costs.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

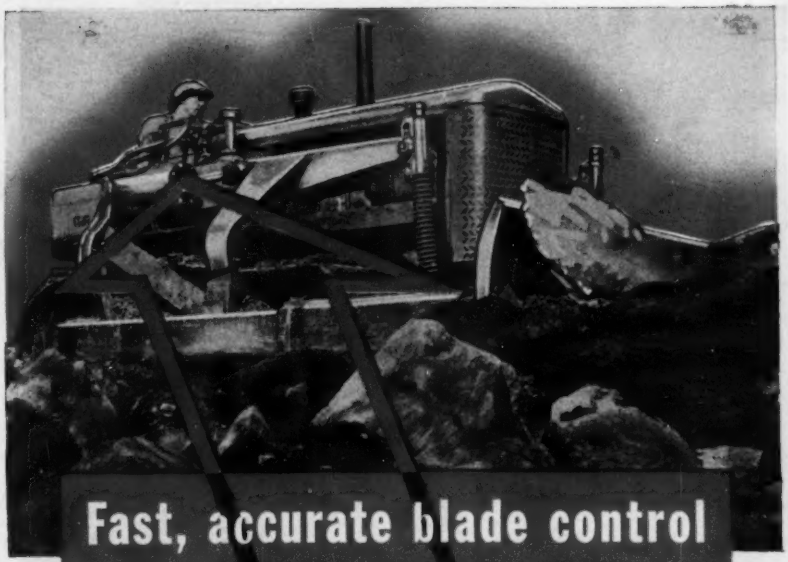
• • •

Air Blaster

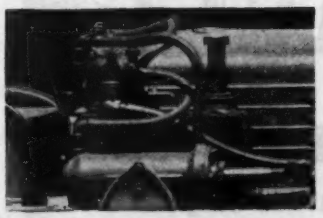
Delivery of a large volume of air in a straight line to the spot where it is needed is a feature of the new Air Blaster. Inaccessible corners and dead air spaces are thus effectively reached, it is claimed. The discharge expands only slightly, continuing as a high-velocity air stream.

The fan unit, made in three sizes, consists of heavy gage welded steel housing, mounted on an adjustable pedestal, which may be tilted 60 deg. up or down.

The fan blade, driven by a direct-connected, ball bearing motor, is heavy steel, die cut, die formed and perfectly balanced.—*Chelsea Fan & Blower Co., Inc., 1206 Grove St., Irvington, N. J.*



Fast, accurate blade control with the sensitive, dependable Heil Hydraulic System on Heil Bulldozers and Trailbuilders for Cletrac Tractors . . .



Troublefree Hydraulic System

Large diameter cylinders, permitting use of low hydraulic operating pressures. Piston rods are chromium plated to avoid rusting and subsequent pitting.

Below:
Heil Hydraulic Pump, equipped with roller bearings for longer life. (Regularly rear-mounted — may be front-mounted.)

Efficient operation depends on instant response to a touch on the controls. That's what your operator gets with the Heil hydraulic system — whether it's rough, tough going among rocks and stumps, or he's doing a "smoothy" on landscape finishing. And he *keeps on getting* that same speed and accuracy, because this is the next thing to a perfect leak-proof unit. It stays in adjustment, gives minimum trouble through a long, hard life. Perfect balance, full visibility, many other Heil features assure you of full loads and bigger profits. Equip with Heil. Write for bulletins.

R-20

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ARMY NAVY

THE HEIL CO.

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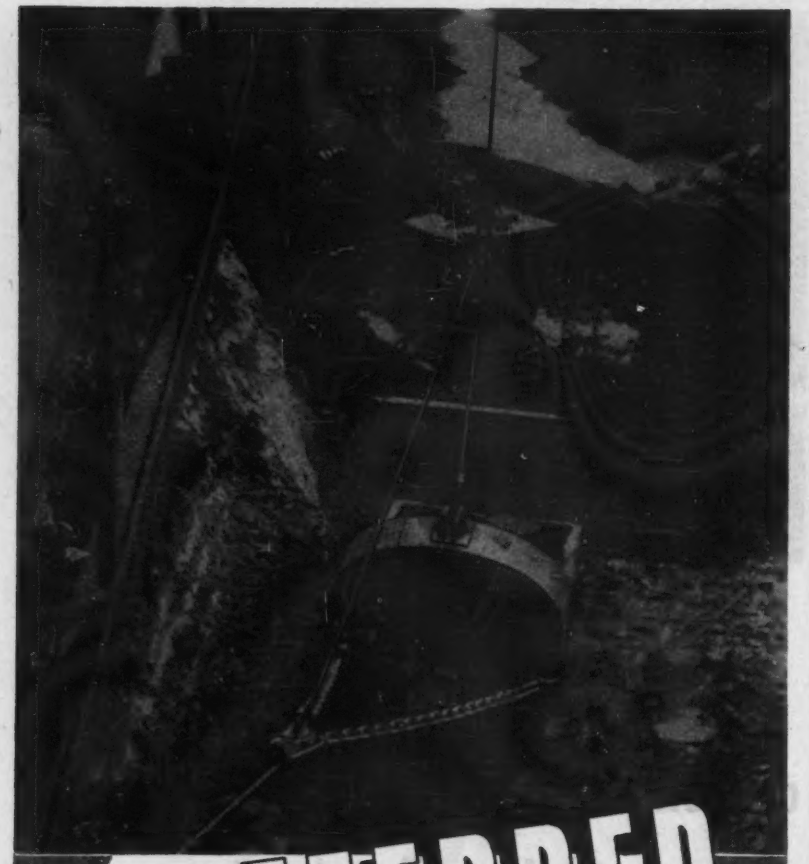

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Why? Because Page AUTOMATIC Dragline Buckets dig—through soapstone, shale and blasted rock. They DIG—and yet they clean off the coal without tearing it up, the AUTOMATIC Digging Action—plus—Page CONTROL.

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MANUFACTURERS' ACTIVITIES

D. J. SHELTON, president and general manager of The Marion Steam Shovel Co., Marion, Ohio, died recently. His death will be a severe loss to The Marion Steam Shovel Co. and to the shovel industry as a whole. He gave 34 years of continuous service to the company and to his untiring efforts are attributed many important developments in material handling equipment and practices.

Mr. Shelton was elected president of the company in 1941, the position he held until his death.

Charles U. Bay has been elected chairman of the board of the company.

THE E. H. KLIEBENSTEIN CO., serving metropolitan New York, has recently added to its line the Davey portable and industrial compressors, truck power take-offs and pneumatic saws, in preparing for extensive postwar construction activity. E. H. Kliebenstein, general manager of the firm, was formerly eastern sales manager for the Link-Belt Speeder Corp. and is well known among eastern contractors. The company will carry a stock of parts and render service on the various types of equipment manufactured by Davey Compressor Co.

HENRY L. GREDE, veteran foundry official and organizer of the Grede Foundries, Inc., Milwaukee, Wis., died recently. As a young man he learned the carriage building business and later organized his own wagon and sled manufacturing firm which expanded into the present Grede industries. Among his survivors are two sons, William, president, and Arthur, vice-president and secretary of the Grede firm.

ANNOUNCEMENT of the appointment of Lawrence H. Gardner to the engineering staff of Allen Corp., Detroit indus-

SPEEDS UP WORK

SAVES MATERIAL

The Construction Industry can well be proud of its war-time production record. Its high-operating efficiency — developed during peace — had much to do to bring the war to its "final phase."

In keeping with a well-established American principle, the contractors and builders of this country have long been quality-conscious about their production tools. This demand for greater efficiency through quality equipment is reflected in the wide-spread acceptance of "HERCULES" (Red-Strand) Wire Rope in the construction field.

Confidence in "HERCULES" (Red-Strand) Wire Rope is well founded, as it is a product of long experience — designed and manufactured to do specific jobs better . . . safer . . . more economically. It is available in both Round Strand and Flattened Strand constructions as well as in Preformed and Non-Preformed types. There is — in this one grade — a right rope for every heavy duty purpose.

The more hours of work you can get out of every pound of wire rope you use, the more steel you save for other vital war purposes. Regardless of the kind or make of wire rope you now have, it will not be able to give you the full service of which it is actually capable unless it is handled correctly and operated under proper working conditions. For further information on the proper use, care and application of wire rope, feel free to consult our Engineering Department.

MADE ONLY BY

A. LESCHEN & SONS ROPE CO.

WIRE ROPE MAKERS — ESTABLISHED 1857

5909 KENNERLY AVENUE — ST. LOUIS, MISSOURI, U.S.A.

NEW YORK - - - - 90 West Street
CHICAGO - - 810 W. Washington Blvd.
DENVER - - - - 1554 Wazee Street

SAN FRANCISCO - - 520 Fourth Street
PORTLAND - - 914 N. W. 14th Avenue
SEATTLE - - - 3410 First Avenue South

NEW CONTRACTOR'S TOOL!
DAVEY 15" PNEUMATIC SAW

Ideal for Wharf, Drydock, Bridge Piling, Railroad operations or for clearing second growth timber where compressed air is available

1. Will make straight edge cuts where angle or square cutting is required for capping work.
2. Can be used above or under water.
3. Standard Cross Cut Saw Blade. Does not require special sharpening equipment.
4. Does not burden operators as entire weight is carried by clamping device.
5. Operates at speed of 225 strokes per minute—cuts 15" timbers in 40 seconds, smaller timber in even less time.
6. Simple in design—can be operated efficiently and maintained by inexperienced workers.
7. Can be used in all weather.

Write for Form E-163 giving complete details.

ARMY E NAVY

Davey also manufactures a complete line of Portable and Stationary Air Compressors, Heavy-Duty Truck Power Take-Offs, and Portable Lighting Units.

DAVEY *Compressor Co.*
PNEUMATIC SAW DIVISION
KENT · OHIO

TRACK HAULAGE IS CHEAPER HAULAGE

PLYMOUTH LOCOMOTIVES

• FROM 2½ TO 70 TONS •

PLYMOUTH LOCOMOTIVE WORKS

Division of The Fate-Root-Heath Co., PLYMOUTH, OHIO, U. S. A.

trial ventilating equipment manufacturer, was made recently by J. J. Hogan, general manager. Gardner, a mechanical engineering graduate of Purdue University, has been engaged in engineering design work for various industrial equipment manufacturers since 1929. Prior to that he was for two years a member of the Army Air Corps stationed at Selfridge Field, Mich.

STUART E. YEATON, native of Seattle, Wash., and graduate of the University of Washington, has been made manager of sales of the electrical wire and cable division of the John A. Roebling's Son's Co., Trenton, N. J. He was employed as a salesman in the Seattle branch from 1934 to 1941, when he was made assistant to W. G. Marks, President of the California Corp. of the Roebling Co. at San Francisco. In May, 1943, he was transferred to the main office at Trenton as manager of sales of round, flat wire and specialties.

WILLIAM BUTLER, 3rd, who started as an apprentice nine years ago in the research department of Lukens Steel Co., has been promoted to advertising manager of Lukens and its subsidiaries, By-Products Steel Corporation and Lukenweld, Inc. Mr. Butler succeeds George M. Gillen, who recently was named assistant manager of combined sales for Lukens and its subsidiaries. Since March, 1938, Mr. Butler has been with the company's sales promotion department. His employment with Lukens began in Sept. 1934. He was transferred to the sales department in Jan. 1937, and in the following year to sales promotion and advertising.

NEW OFFICES of Pittsburgh Equitable Meter Co.-Merco Nordstrom Valve Co. have been opened in Atlanta, Ga. C. C. Moore, who has been in charge of the Memphis office, is district manager. The offices are at 411 Bona Allen Bldg. Spring and Luckie Sts. The Memphis office will be closed and all southern operations will be handled through Atlanta.

WILLARD BURTON, 93, considered the

"dean" of the Texas lumber industry, died at Fort Worth, recently. Mr. Burton began lumbering in Missouri. He went to Texas on the first passenger train into Fort Worth in 1876. He founded the lumber firm of Burton Lingo & Co. In 1896 this company became Burton-Lingo Co., Inc. Mr. Burton headed this company as president and later as chairman of the board, till he retired five years ago.

G. K. HAYES, who has represented the John A. Roebling's Sons Co., manufacturers of wire rope and wire, Trenton, N. J., as a salesman out of the company's Cleveland branch for several years, has been appointed assistant manager of that branch. Mr. Hayes is a graduate of the University of West Virginia and has been connected with the company since 1930.

MORE THAN 40 big CMC 10-inch centrifugal pumps played an important part in salvaging the U.S.S. *Lafayette*, former French liner *Normandie*. These 10-inch pumps, made by Construction Machinery Co., Waterloo, Ia., handled most of the 100,000 tons of water pumped from the hull. Other centrifugal pumps in smaller sizes were also used on the job by the Navy and the Merritt, Chapman, Scott Corp.

WILLIAM G. THEISINGER, who has been director of welding research at Lukens Steel Co., Coatesville, Pa., since Feb. 1941, has been appointed assistant to the vice president. Dr. Theisinger will assist D. S. Wolcott in the manufacture, sale and application of special products such as clad steels. Dr. Theisinger joined Lukens in August, 1935, as welding and metallurgical engineer and has specialized in the handling of technical matters in the application, fabrication and sale of the company's products.

W. G. MARSHALL, vice-president of industrial relations at the Westinghouse Electric & Mfg. Company, has announced the appointment of C. A. Smith as assistant to Thomas I. Phillips, vice-president of the East Pittsburgh Divisions. Mr. Smith, who has been

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are weight-proportioned to sink their husky teeth in—and power-reeved (up to 7:1) to dig down for a heaping payload at every grab. Ask any crane operator!
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Bucket agencies throughout the country. Write, wire for prices, delivery and catalogs.

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. . . are built faster and better with Douglas Fir Plywood

• When the job has to be done FAST . . . when a building must be durable and weatherproof, architecturally-correct and pleasing—Douglas Fir Plywood provides the ideal answer for both planner and builder.

This modern, engineered Miracle Wood is serving the war effort in countless ways—for buildings, boats, crates, railroad cars. And after victory it can serve you, too—as one of your most useful construction materials.

To help speed victory, the Douglas Fir Plywood Industry is devoting its entire capacity to war production.

• DURABLE DOUGLAS FIR PLYWOOD WAS USED THROUGHOUT IN THIS IMPRESSIVE NEW OFFICE BUILDING FOR THE OREGON SHIPBUILDING CORPORATION IN PORTLAND. THE ENTRANCE FEATURES INTERESTING CURVED EFFECTS POSSIBLE WITH THIS MODERN MIRACLE WOOD.

DOUGLAS FIR PLYWOOD
Real Lumber
MADE LARGER, LIGHTER
SPLIT-PROOF
STRONGER

Stronger Per Pound Than Steel

with the company for 51 years, was manager of factory service at the East Pittsburgh plant. In his new capacity, he will assist Mr. Phillips in the administration and coordination of manufacturing activities. Joining Westinghouse in 1892 as an apprentice, Mr. Smith has since that time served as assistant foreman, general foreman, assistant superintendent, superintendent and division manager.

ALLEN W. CLARKE, formerly mechanical engineer in charge of the a.c.f. Western Engineering Division, American Car and Foundry Co., has been appointed assistant general mechanical engineer with headquarters at St. Charles, Mo.

Mr. Clarke was born in Jeffersonville, Ind., and received his early education in the Jeffersonville, Ind., public schools. He is a graduate of Purdue University, class of 1907, and received his Master's Degree of Mechanical Engineer at that institution. He began his employment with American Car and Foundry Company in the summer of 1905, thus gaining practical experience while getting his theoretical training.

Mr. Clarke is known throughout the industry as an authority on passenger car building and has invented a number of patents, all of which are assigned to American Car and Foundry Co.

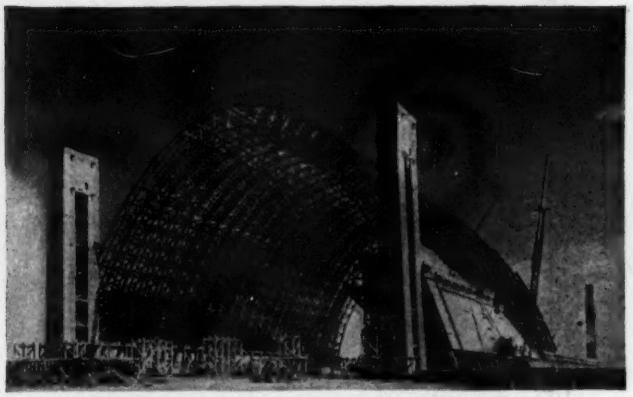
W. F. DIETRICHSON, formerly assistant general mechanical engineer at the a.c.f. Berwick, Pa., plant, has been appointed general mechanical engineer at Berwick.

Other appointments are: Victor R. Willoughby, vice president, formerly in charge of engineering, has been made director of research and development; Edmund D. Campbell, formerly general mechanical engineer, is now vice president in charge of engineering, succeeding Victor R. Willoughby; Alvin A. Borgading, formerly general purchasing agent, has been appointed vice president in charge of purchases.

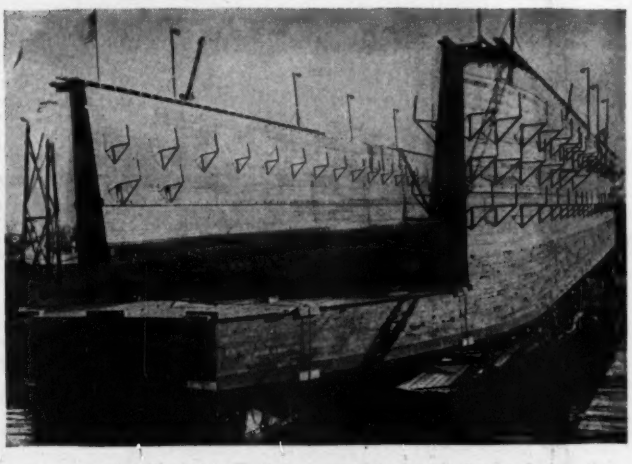
A. G. HENDRICKSON and George E. Geyer of the welding division, Harnischfeger Corp., Milwaukee, Wis., have been appointed sales representatives for that product in the entire Milwaukee area.

THE NAVY BUILDS WITH WOOD

Timber Hangars for the Navy's war planes.



Blimp Dock. The world's largest clear span timber structure recently completed by the Navy. 1000 feet long, 153 feet high, clear spanning 237 feet.



Floating Drydock. Timber connectored structure for vessel repair at sea.

Since Pearl Harbor, the U. S. Navy has used over 2,000,000,000 feet of lumber and timber as a structural material at home and overseas bases.

This spectacular use of lumber and the Navy's wide application of the Teco System of Timber Construction have advanced the science of timber engineering. You, too, may have the advantages of timber construction. . . . . strength, economy and permanence . . . . now and in peacetime.

Here is sound engineering advice . . . . . *Design* in timber . . . . *Specify* Teco Connectors . . . . *Employ* a Teco Timber Fabricator.

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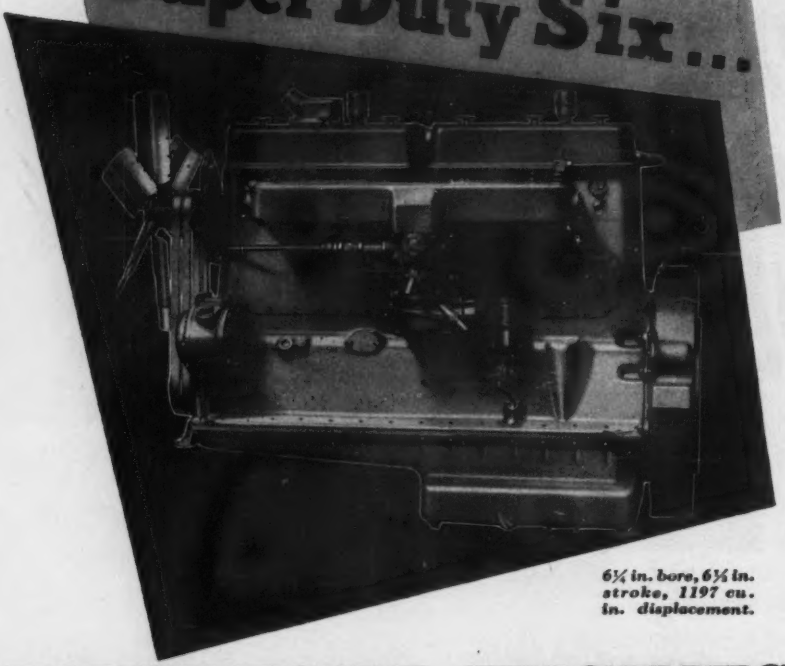
Model WAK Super Duty Six...



6¼ in. bore, 6½ in. stroke, 1197 cu. in. displacement.

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The Super Duty Six lives up to its name. Built to take it . . . and take it . . . and still be able to dish it out. Rugged . . . to the last fine detail . . . from oil pan to head.

Crankcase and cylinder frame are cast as one unit . . . so braced as to give the entire structure *remarkable rigidity*. Riding in its seven hefty, husky, four-inch bearings, the heat-treated steel crankshaft is positively aligned . . . stays that way.

When servicing a Super Duty Six, you do it the easy way—that's another Waukesha construction advantage. Valve grinding is simplified. Since it's an overhead valve engine, you remove the heads and do it where it's most convenient. Each cylinder is a wet type sleeve. Press it from the main case and replace it—it's that easy.

Include this Waukesha Engine in making your postwar plans. Write for Bulletin 1138.

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Safety Booklet—A guide to greater safety and finer workmanship has been produced as a 36-page handbook for workers. The manufacturer's foreword is: "The management has set forth herein a few simple rules and suggestions for you to follow, that will make your working hours safer, more pleasant and more productive."—*Economy Pumps, Inc., Hamilton, Ohio.*

Prime Pumps—A catalog entitled "How to Pump It" contains information concerning the construction of the pump, how it operates, and what it will do. Also included are specifications and capacity charts to aid in pump selection.

Prime pumps are made in capacities ranging from 3000 g.p.h. to 125,000 g.p.h. They have found application in many industries, and for pumping many fluids. Their chief use is for dewatering purposes, and for this service the outstanding advantage is said to be their positive self-priming feature.—*Chain-belt Co., 1600 West Bruce St., Milwaukee, Wis.*

Hardwood Plywood — An illustrated booklet briefly traces this company's history, products and personnel.

Sixty-six years of development are reflected in the numerous sketches and photographs, detailing ramifications into a variety of industries and trades which use veneers, plywoods, lumber and machined wood products, and other parts of prefabricated houses.

The booklet is likewise illustrated by photographs of such war products as

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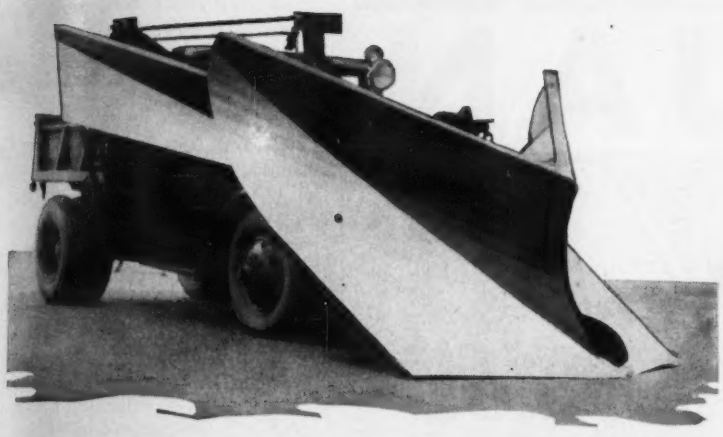

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Army cargo truck body parts; aircraft plywood; military boat plywood, boxes for the fighting services, airplane engine boxes, airplane crates, etc.—*The Mengel Co., Louisville, Ky.*

Cableways—The advantages of this manufacturer's cableways, winches, hoists, unloaders, joists, caissons, logging machinery and many other similar products are interestingly portrayed by photographs and text in a new booklet which ought to be in every engineer's or constructor's files—*Lidgerwood Mfg. Co., Elizabeth, N. J.*

Tungsten Electrodes—Tungsten electrodes for atomic hydrogen, helium and argon arc welding are widely used in war industries where they have been found quick and efficient for the manual and automatic welding of such metals as aluminum, duraluminum, nickel, chrome, monel metal, molybdenum steels, copper, stainless steel, brass and bronze. A bulletin just issued describes these electrodes and gives complete data on those available—their physical properties, dimensions, and current range in amperes. Users of welding electrodes will find this bulletin interesting and informative. *Callite Tungsten Corp., 540 Thirty-ninth Street, Union City, N. J.*

Redesign by Arc Welding—A new data service in loose leaf form titled "Practical Design for Arc Welding" is being released by a manufacturer of electric arc welding equipment. It is a new design and suggestion service, replete with time-saving suggestions for economical design of change-overs or new products.

In order to stimulate those who have reconstruction problems in production, processing construction and maintenance of equipment, this company engaged Robert E. Kinkead, independent welding consultant, to prepare a series of design suggestions based on his actual experience.

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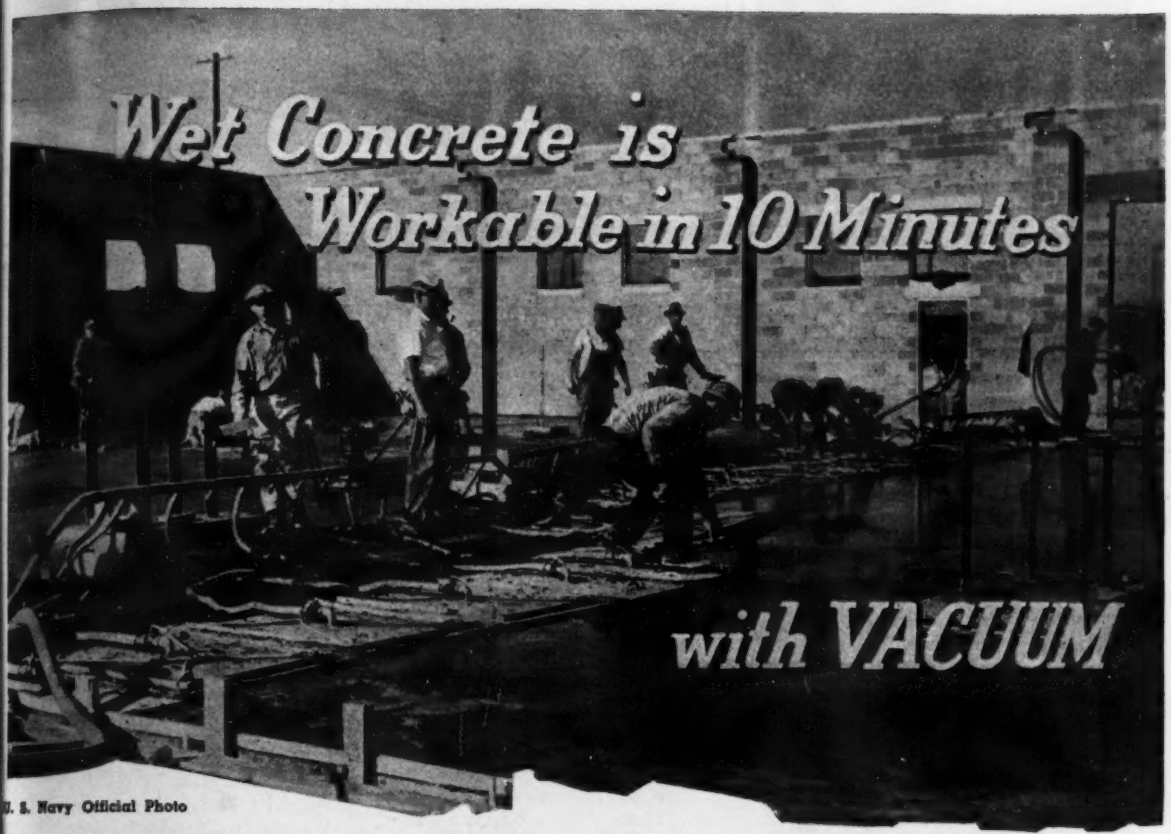

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It usually takes only 10 minutes' application of the Vacuum Process to remove excess water and make the concrete ready for finishing.

Hence, the vacuum process proceeds as fast as the concreting and the finishers follow apace.

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Concrete was *wet* when placed and water flushed freely to the surface when it was screeded. You can see the light reflected by the floor—before VACUUM was applied.

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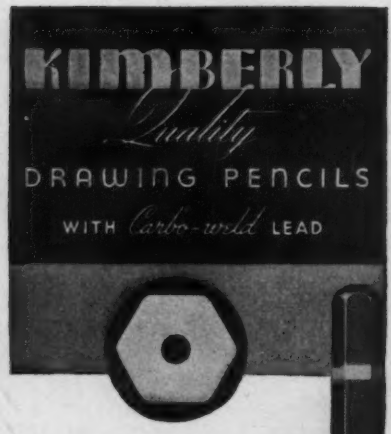

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new sheets offer suggestions of such universal application that the matter of size and detailed specifications is left open. *Hobart Brothers, Troy, Ohio.*

Heat Measurement—An 8-page bulletin describes the "potentiometer" method of heat measurement, and explains the electronic principle employed in the company's instruments to gain instant control in line with the temperatures recorded. Also included is a list of instrument features, four operating diagrams, and a table of potentiotrol scale ranges obtainable with various thermocouples and a photoelectric pickup unit. *Wheelco Instruments Co., Harrison and Peoria Sts., Chicago 7, Ill.*

Registers and Grilles—Air conditioning registers and grilles are thoroughly described and illustrated in a 40-page catalog. A wide variety of types and uses are shown with specifications and prices. This same company also issues a fine catalog of air diffusion equipment—*The Waterloo Register Co., Waterloo, Ia.*

Fire Pumps—A folder describes gasoline engine driven fire pumps of 500 GPM, 750 GPM and 1000 GPM capacity ratings. Special features are clarified by means of detail diagrams. *Fairbanks, Morse & Co., Chicago, Ill.*

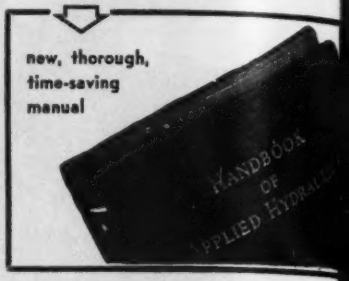
Pipe and Tube Bending—An 80-page handbook profusely illustrated and containing many helpful charts tells the whole story of pipe and tube bending.—*Copper & Brass Research Assn., 420 Lexington Ave., New York, 17, N. Y.*

All About Turbines—A very attractive booklet of 24 pages tells of the development of the turbine idea from the beginning back in Egypt 2,000 years ago to the latest product of today's war production plants. It is a booklet that every engineer and manufacturer will want to keep for reference.—*General Electric Co., Schenectady, N. Y.*

Safety Goggles—An illustrated booklet entitled "Right on the Nose," explains the easiest methods of adjusting non-prescription industrial safety goggles so that workers can wear them in comfort. It was prepared for safety directors, medical directors, or others fitting goggles to help prevent eye accidents caused by workers refusing to wear improperly fitted safety goggles uncomfortable to wear.

A training film on the same subject has also been produced. This new sound motion picture 16 mm. film is available on a free loan basis, and prints may be obtained direct from the company.—*American Optical Co., Southbridge, Mass.*

. . . *to help you*
plan and design hydraulic works
quicker—better



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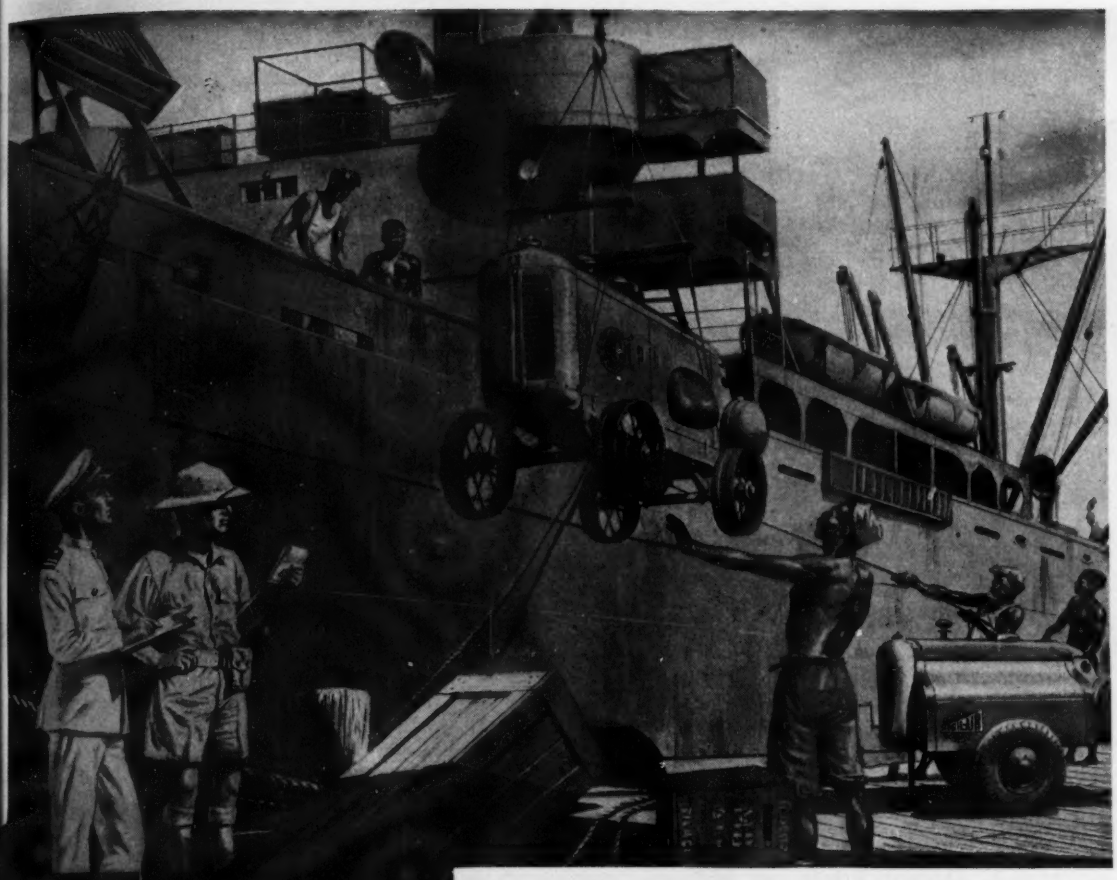

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MOBIL-AIR Compressors were designed for peacetime operations, yet for jobs so tough that they go to battle now with no change except their coat of war paint.

But, because of new features incorporated before Pearl Harbor, MOBIL-AIR Compressors now occupy less space, weigh less, and *use much less fuel.* These save priceless cargo space and weight in the freighters that transport the machines, and reduce the gasoline that must be carried over there to do the job. Such features will be equally valuable in the reconstruction period after victory has been won.

These machines are used by the fighting forces to build and repair roads, bridges, bases, landing fields, gun emplacements, pillboxes, tank traps, fuel storage...to save time and money.

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PREVIEW OF TOMORROW'S PIPE LINES

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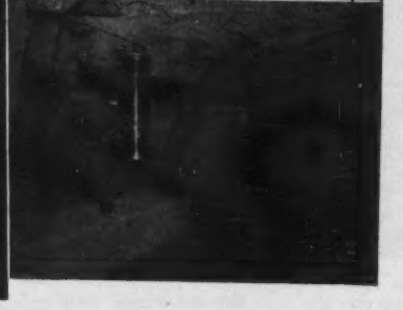

Nowhere are the built-in advantages of Naylor Lockseam Spiral-weld Pipe better demonstrated than in construction service. Naylor's combination of light-weight, leaktightness, extra strength and safety is found in no other light-weight pipe. Along with these performance factors, you get savings in shipping, handling, installation and maintenance.

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TOMORROW'S SPECIFICATIONS CALL FOR THESE NAYLOR ADVANTAGES

- Always accurate in diameter.
- Concentric ends match correctly.
- Easier to install.
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- Stays tight and leakproof.
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- High salvage value.
- Light weight saves steel.
- Cuts maintenance costs.
- Saves money.

Sizes 4" to 30" in diameter—all types of fittings, connections and fabrications.

Naylor

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MEN AND JOBS

R. H. Wilcomb, formerly division engineer at Lewistown, Mont., for Montana state highway engineering department, has been named maintenance engineer for the department, with headquarters at Helena.

Robert B. Atkins, who received degree in civil engineering at the D University School of Engineering, D ham, N. C., in 1932, now is a lieuten commander in the United States N Reserve and is stationed in the C Engineering Corps at the Naval M Depot at Yorktown, Va.

Col. Thomas C. Green, former su intendent of the city water filtra plant at Austin, Tex., has been awar the Legion of Merit for distingui work in leading his combat engineer regiment in the Sicilian campa Green is a graduate engineer of University of Texas.

R. R. Lacy, city designing engi at Fort Worth, Tex., has been n supervisor of the newly created waste disposal service of Fort Worth

W. W. Horner, consulting engi of St. Louis, has been employed by city of Houston, Tex., as consulting gineer on sewerage problems in $1,200,000 sanitary sewer and the 000,000 storm sewer work Houston considering.

H. M. Woodhouse has been pointed City Engineer of Fort Willi Ont. Mr. Woodhouse has been in service of the city for 26 years and been acting city engineer since Ap 1942.

Town Engineer Isaac J. Casey Irvington, N. J., observed his 35th

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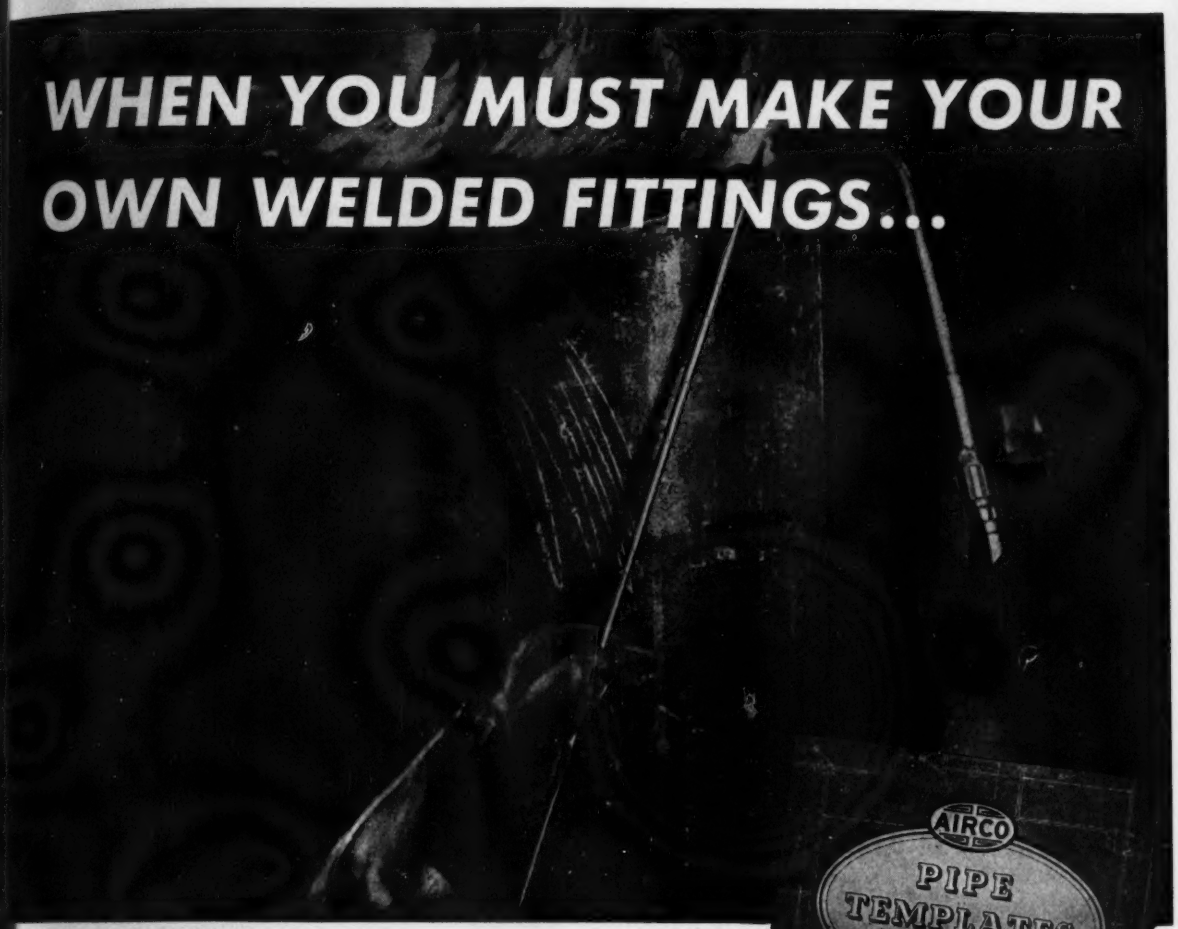

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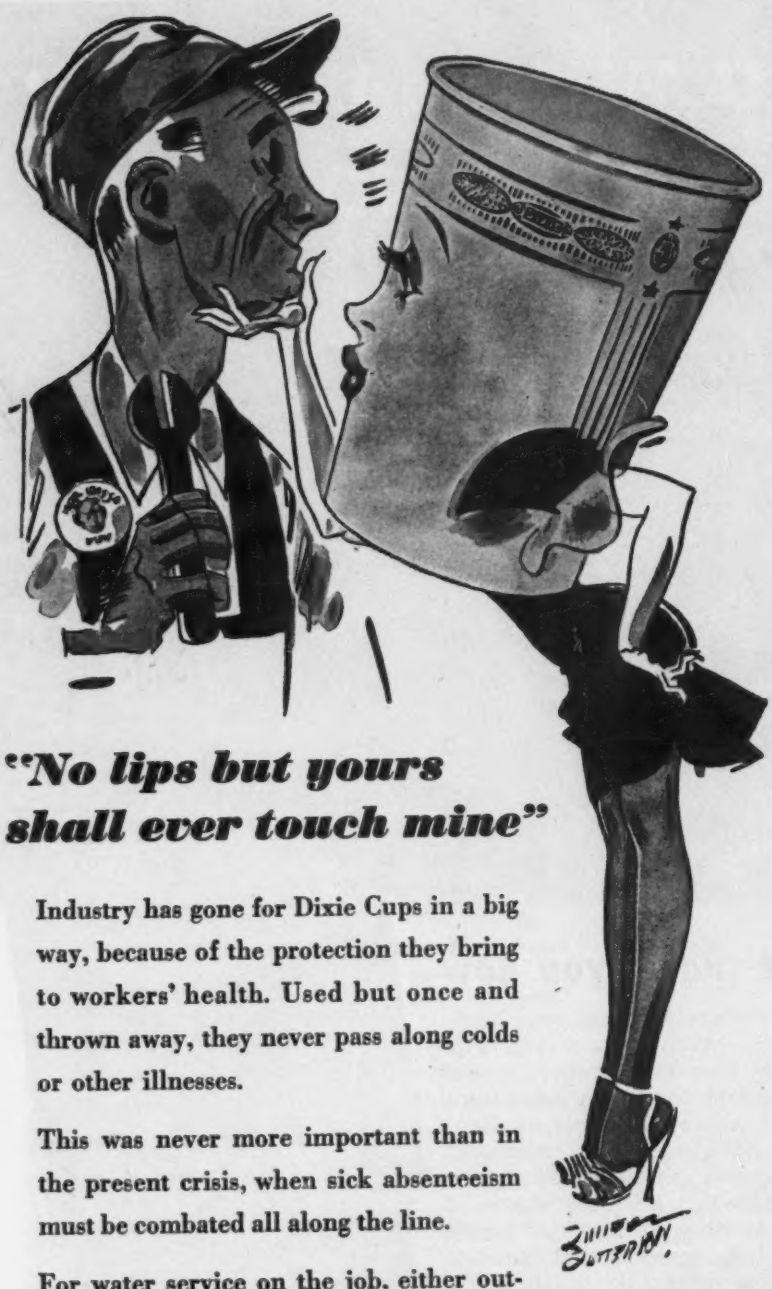

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DIXIE CUPS

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niversary as town engineer Jan. 1. He is the dean of the town's employees. When he was appointed engineer in 1909, the town had only five paved streets. His work has included supervision of plans for most of the town's sewers and supervision of refuse collections. In addition to his regular work, he is kept busy making postwar plans for the planning board.

Captain Mont S. Johnston, formerly of the Denison, Tex. District Army Engineers Control division, has been made a major. He is stationed at Fort Belvoir, Va., as an instructor in the Army Engineering Corps.

Simon W. Freese, consulting engineer of Fort Worth, Tex., has received the commission of major in the Allied Military Government Service, which will administer the military governments in Allied-occupied territories. Major Freese has reported for duty at the University of Virginia. He is a graduate of the Massachusetts Institute of Technology. Associated with Marvin C. Nichols and the late Major John R. Hawley, he has built millions of dollars worth of municipal and military installations, camps and structures throughout the Southwest.

A dispatch from Italy says that Lt. Col. **C. Rockwell,** assistant city engineer at Council Bluffs, Ia., has twice been promoted there. His commanding general went through two miles of artillery fire to pin the new insignia on him personally for the action of his battalion.

Karl S. Smith, Youngstown, Ohio, has been commissioned a lieutenant in the Army engineers corps and has reported for duty at Fort Belvoir, Va. Smith has been assistant area engineer for the army in a civilian capacity in Hawaii for the last 18 months.

Coleman H. Cook has been appointed chief designing engineer of the

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bridge division, Texas State Highway Department. Mr. Cook has been senior design engineer for the department for a number of years. James P. Exum, bridge engineer, said that the appointee by reason of his many years of constructive bridge design experience was given this additional responsibility as a part of the plan to strengthen the bridge division for the job of preparing postwar plans and specifications.

Maj. Paul E. Werner, area engineer at Camp Butner, N. C., has been transferred to the staff of the U. S. Engineer Office, Wilmington, N. C., as assistant to Lt. Col. J. T. Knight, district engineer. **Maj. Loren A. Wilson** of Greensboro, N. C., formerly connected with the Wilmington office, has succeeded Maj. Werner as area engineer at Camp Butner.

The North Carolina office of the surface water division, Water Resources Branch, United States Geological Survey, has been moved from Asheville, N. C., to Raleigh, N. C. Making the move were District Engineer E. D. Burchard and his staff of engineers and clerical workers.

Robert S. Wheatley, has been appointed city engineer in East Liverpool, Ohio, replacing George S. Bloomgren. **Vincent J. McGeehan,** has been chosen operating foreman of the city waterworks there, succeeding Edgar B. Laughlin.

George M. Shepard, chief engineer, Department of Public Works, St. Paul, Minn., on leave of absence to the Alcan Highway Mar. 1 to Oct. 1, and to the Metropolitan Airport Commission of Minnesota from Oct. 1 to Dec. 31 last, has been returned to the Department of Public Works and taken his position as chief engineer. **Wright S. Cockroft,** acting chief engineer during Mr. Shepard's absence, has returned to his position as assistant chief engineer and **George M. Garen,** acting assistant chief

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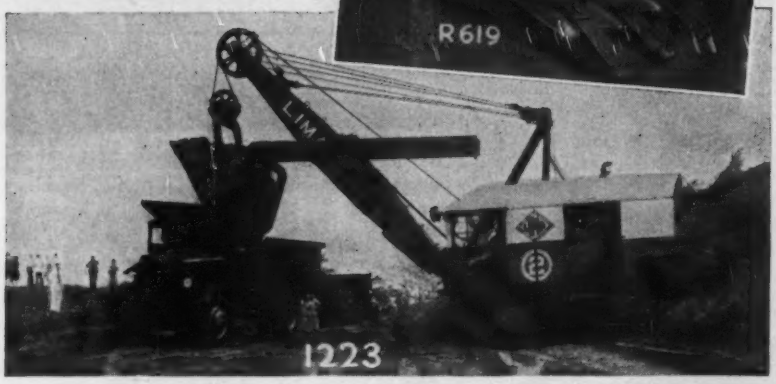
A Generation on the Job—*Amsco Dippers at Panama*

Amsco manganese steel dippers have been used at Panama since 1914 and have played an important part in keeping the "big ditch" open. Those employed 30 years ago were the Missabe type, like the 10 yard bucket shown in picture 431. Its design and the toughness of austenitic manganese steel made the Missabe such a big advance over any previous dipper that it is still used in some fields, despite the major improvements which have since been made in Amsco dipper design.

Today Amsco renewable lip dippers are on the job in the Canal Zone. Picture 1223 shows a 3½ yd. renewable lip dipper on a Lima shovel owned by the Martin Wunderlich and Okes Construction Companies, contractors. This shovel is shown digging in on the third locks job at Gatun. Before this job is completed, 12,000,000 yards of dirt and rock will have been moved.

No matter what the nature of the material handled, Amsco dippers, being made of "the toughest steel known," resist impact and abrasion longer than dippers made of other steels. The design of the renewable lip dipper, shown in picture R-619, contributes rapid, full loading and clean dumping. The smooth interior obviates clay building or arching of material. The lips and teeth are shaped for fast, clean cutting. The lip, which receives the brunt of the wear, is readily renewable.

Ask for Bulletins 641-D and 641-S on Amsco power shovel dippers and power-shovel parts.



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engineer, has returned as assistant superintendent of construction and repairs.

C. W. Smedburg, former city manager of Greensboro, N. C., who has been serving in Washington since last October as regional engineer of the water supply section, water division, Office of War Utilities of the War Production Board, has been named assistant regional director of Region 4 of the Federal Public Housing Authority, with headquarters at Atlanta, Ga.

Kenneth M. Adelstein, architectural engineer, Bureau of Yards and Docks, Washington, has been assigned to Smaller War Plants Corporation with offices in Richmond, Norfolk and Roanoke, as a procurement specialist.

Fred A. Nolte is the new superintendent of the board of public works, Ashland, Ky., he has been in the real estate and engineering field for 20 years.

Ernest I. Wood, Jr., of Raleigh, N. C., civil engineer with the North Carolina State office of the WPA until he entered the Army, has been graduated from the Officer Candidate School at Fort Belvoir, Va., and has been commissioned a second lieutenant in the Corps of Engineers.

James A. Anderson, state highway commissioner of Virginia, has announced the promotion of **L. E. Akers** from district engineer, Petersburg, to assistant state maintenance engineer and of **Joseph H. Wyse** to district engineer. Mr. Wyse is on leave serving as state civilian defense coordinator. Pending Mr. Wyse's return, **P. W. Snead** will be acting engineer in the Richmond district.

William D. Darby, former city engineer for West Allis, Wis., and at present conducting his own consulting engineering service, has been appointed to the

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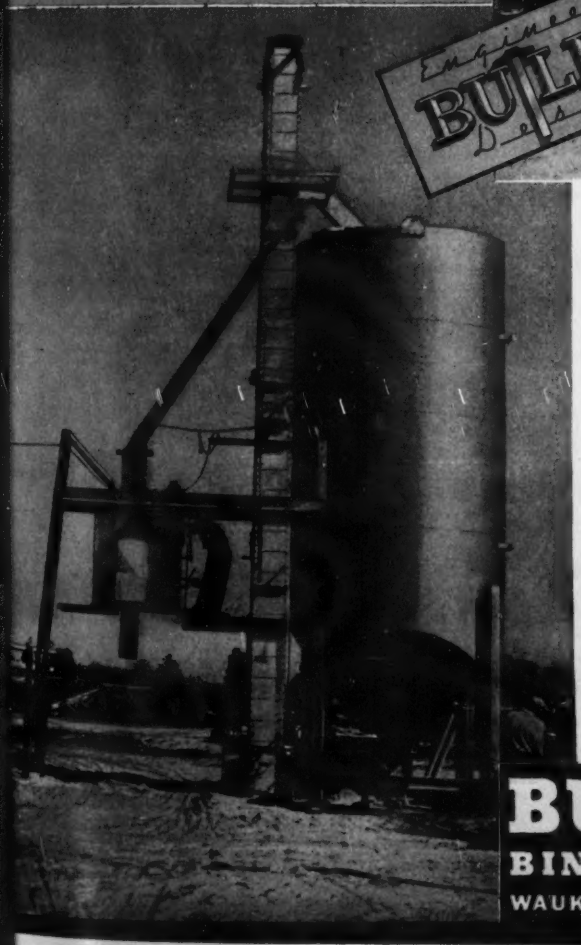

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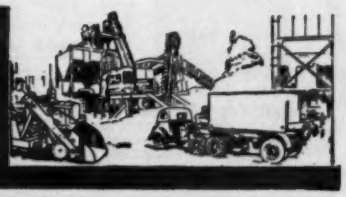

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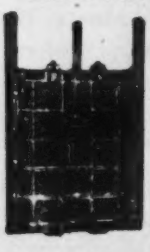

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Col. W. W. Wanamaker, Denison District Army Engineer since Aug. 1, 1941, was relieved of his command Jan. 10 and assigned to foreign duties. **Maj. E. J. Wanless** is expected to become district engineer.

A. H. Cunningham, who has been on leave of absence to work on the Alaska Highway, has been rehired as county engineer of Buena Vista County, Ia.

James S. Wearn, who received his civil engineer degree from the University of North Carolina, has been made assistant chief engineer of maintenance of way and structures on the central lines of the Southern Railway System. With headquarters at Knoxville, Tenn., he succeeds Edgar Bennett, now chief engineer.

Col. Alexander M. Nielson, for the past two years district engineer at Little Rock, Ark., for the U. S. Engineers, has been transferred to overseas duty. Colonel Nielson was district engineer at Kansas City before going to Little Rock. **Lt. Col. G. R. Schneider,** former chief of the engineering division, is now acting engineer at Little Rock. For the past two years he has served as chief of the engineering division, and previous to that he was head of the design section. He also worked on the Muskingum, Ohio, flood control project and on Conchas and Denison dams.

Robert C. Rateliffe has been appointed City Engineer of Laramie, Wyo.

George Henningsen, acting county engineer at Marshalltown, Ia., has resigned to enter the employ of the Gibbs-Cook Tractor and Equipment Co. at Des Moines.

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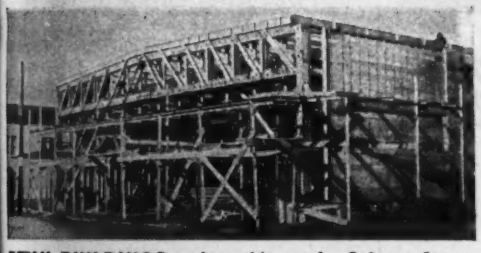

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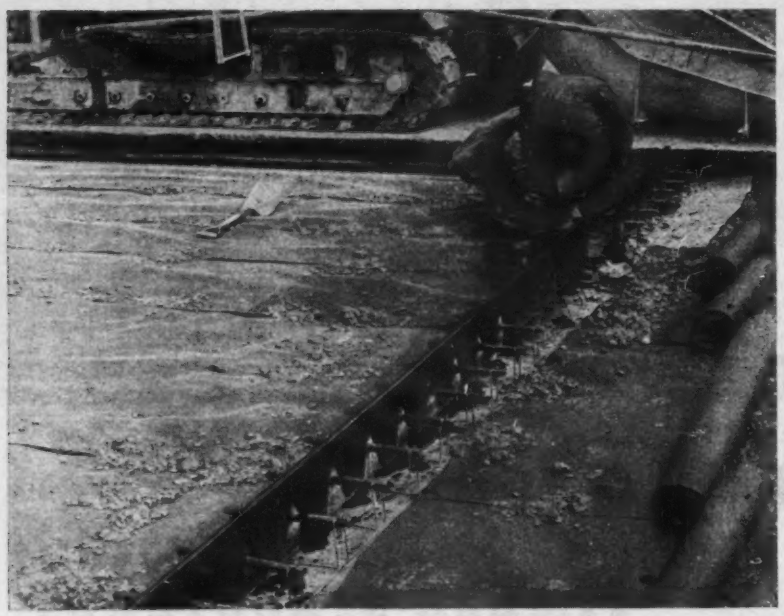

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MEETINGS

AMERICAN ROAD BUILDERS' ASSOCIATION, 41st annual convention, Edgewater-Beach Hotel, Chicago, Ill., Feb. 1-3.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, 25th annual meeting, Drake Hotel, Chicago, Ill., Feb. 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, spring meeting and committee week, Netherland Plaza Hotel, Cincinnati, Ohio, Feb. 28-March 3.

AMERICAN CONCRETE INSTITUTE, 40th annual convention, Palmer House, Chicago, Ill., Feb. 29-March 2.

NATIONAL CONFERENCE ON POSTWAR HOUSING, Drake Hotel, Chicago, Ill., Mar. 8-10.

REGIONAL AND LOCAL MEETING

NEW JERSEY SOCIETY OF PROFESSIONAL ENGINEERS, 24th annual convention, Hotel Plaza, Jersey City, N. J., Jan. 29.

TEXAS WATER WORKS AND SEWAGE SHORT SCHOOL, 26th annual meeting, Texas A. & M. College, College Station, Tex., Jan. 31-Feb. 2.

CONSTRUCTORS ASSOCIATION OF WESTERN PENNSYLVANIA, annual meeting and dinner, Hotel William Penn, Pittsburgh, Pa., Feb. 1.

SOUTHEASTERN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, Hotel Roanoke, Roanoke, Va., Feb. 9-10.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, 20th annual meeting, Hotel Pennsylvania, New York, N. Y., Feb. 17-18.

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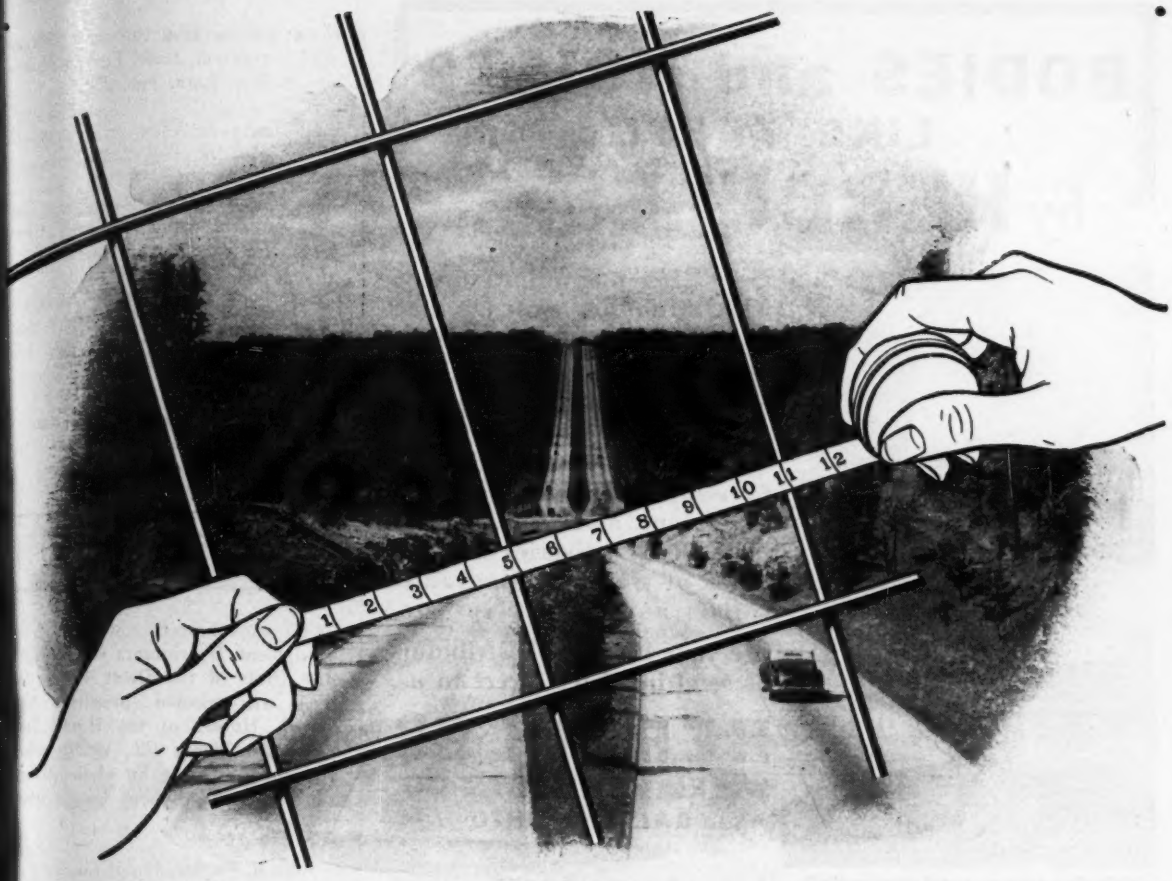

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You'll find that "placing costs" are *lower* when you use Clinton Electrically Welded Reinforcing Fabric.

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STRENGTH—Ultimate tensile strength of not less than 70,000 lbs. per sq. inch in accordance with A.S.T.M. Serial Designations A 82-34 and A 185-37.

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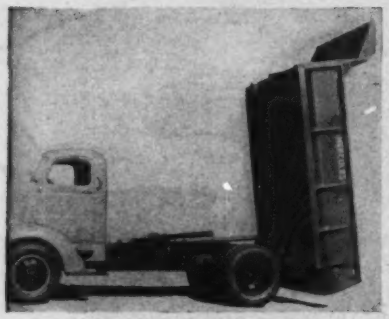

Hercules High Dumper
Power up, Power down

are giving maximum service with minimum expense, day after day, on the home front. "Victory is our business", and our war production is playing an important part in bringing victory nearer; but production for essential civilian use is also important, and we're able to make quick deliveries on many types of Hercules Hydraulic Hoists and Bodies to you.

See your Hercules Distributor, or send inquiries direct to us.

Hercules Low-mount Sanitary Body

HERCULES
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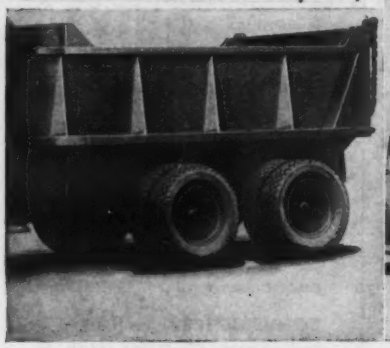

Hercules Braced Side Rub Rail Body

Hercules 6-Batch Coal Body

IOWA ENGINEERING SOCIETY, 55th annual convention, Hotel Ft. Des Moines, Des Moines, Iowa, Feb. 23-24.

ILLINOIS STATE ASPHALT CONFERENCE, Springfield, Ill., Feb. 23-24.

MICHIGAN HIGHWAY ENGINEERING CONFERENCE, 30th annual meeting. Grand Rapids, Mich., Feb. 8-March 1.

THE NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION, the Hotel Madison, Atlantic City, New Jersey, Mar. 15, 16 and 17.

NEW JERSEY SEWAGE WORKS ASSOCIATION, 29th annual meeting. Stacy-Trent Hotel, Trenton, N. J., Mar. 23-24.

Elections and Activities

At the annual meeting of the Wisconsin Equipment Distriubtors in Milwaukee Ray Drott of the Drott Tractor Co., Inc., was elected president. Morton R. Hunter of the Hunter Tractor & Machinery Co., vice president, and John V. Coughlin of the Milwaukee Power Equipment Co., secretary-treasurer.

John R. Purser, Jr., of Charlotte, has been elected chairman of the North Carolina Section of the American Water Works Association, succeeding W. H. Hall of Durham, dean of the Duke University School of Engineering. E. M. Johnson of Raleigh was elected vice-chairman; R. S. Phillips of Durham was renamed secretary and treasurer; and D. McG. Williams of Durham and J. W. Kellogg of Raleigh were elected trustees. W. M. Piatt of Durham was elected director of the American Water Works Association and W. M. Franklin of Charlotte was elected a director of the Federal Sewage Works Association.

Harry L. McFeaters, chief engineer

EPPINGER AND RUSSELL CO.
Wood Preservers Since 1878
All kinds of Structural Timbers and Lumber Pressure Treated with Creosote Oil or
DU PONT CZC Chromated Zinc Chloride
80 EIGHTH AVE., NEW YORK, N. Y.
POLES, CROSS ARMS, PILING, TIES POSTS, BRIDGE AND DOCK TIMBERS
TREATING PLANTS
Jacksonville, Fla. Norfolk, Va.
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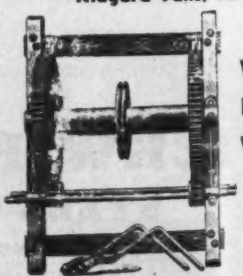
Fast, Dependable
SHOVELS, CRANES
DRAGLINES, BACK HOES
Crawler or Truck—Gas or Diesel
10 Models of 3/4-5/8-1/2-3/8 cu. yd.
THE **BYERS** MACHINE COMPANY
RAVENNA, OHIO
DISTRIBUTORS THROUGHOUT THE WORLD

DOBBIE FOUNDRY & MACHINE CO.
Niagara Falls, N. Y.

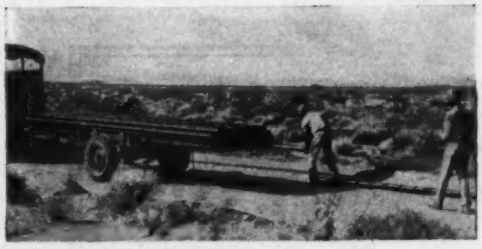


Wood Frame Winches
(Write for Catalog)
Derricks—Winches—Sheaves

Crew Laying Mobile Pipe Line—U. S. Army Photograph

GASOLINE *in a* DESERT?

That was one problem which confronted the Corps of Engineers as it planned for the supply of our mechanized equipment and our flyers with precious high-test gas. So was gasoline in a jungle. And gasoline on mountain-tops blasted out for landing fields.



This is how Pipe is distributed—U. S. Army Photograph

They knew that it was one thing to lay pipe lines through country where the route could be picked—but it is a very different matter when the location of an enemy force dictated the route our soldiers have to travel.

And the difficulties multiply vastly when an enemy force is located far inland, with only faintest trails through densest undergrowth to guide our troops.

It is under these circumstances—and worse, you can be sure—that Army pipe lines are being laid. Life-giving arteries winding through the wastes, bringing offensive power to our men, driving always forward, and forward some more.

Pipe is not a pipe line. A pumping station isn't either. Neither are the ingenious couplings which lock each length of pipe to its neighbor, and seal in the precious fluid brought so carefully from thousands of miles away by armed and convoyed tankers. No, none of these, by itself, is a pipe line. But altogether they are.

Is it any wonder the Engineer Board at Fort Belvoir, and the Office of the Chief of Engineers in Washington, studied so eagerly the early beginnings of automatic pipe lines established in this country by private industries? Or so quickly adapted and redesigned these early beginnings into the simple, quickly assembled, fast, efficient, portable pipe lines now in use in every theatre of war?

Numerous companies co-operated with the Corps of Engineers in these original studies; and are now co-operating in the supply of needed components. We are proud to have been associated with the project from its earliest inception by the Corps of Engineers.

GUSTIN-BACON MANUFACTURING CO.

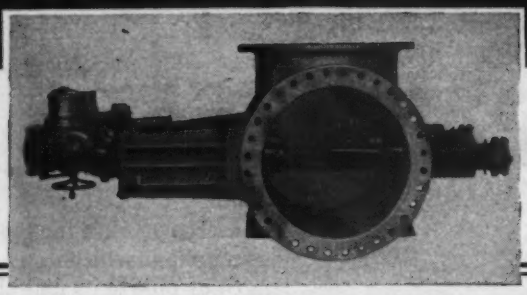
GRUVAGRIP COUPLINGS

One of the Co-operating Companies

KANSAS CITY 7, MISSOURI

W YORK • PHILADELPHIA • CHICAGO • TULSA • HOUSTON • SAN FRANCISCO

At Last!



Weight of unit — 8500 lbs. Note dual finned, lubricated stuffing boxes for elevated temperature and high working pressure.

SIMPLICITY...
in a Three-Way Valve

(Patent Applied For)

The simplified design and quick action of the modern R-S Butterfly Valve has been applied to a three-way valve, which is unequaled for quick interchange and mixing service. Rugged construction for all pressures from 15 to 900 psi. Adapted to manual control as well as power operation and elevated temperatures.

Here, then, is another example of R-S Valve Engineering that has proved its superior efficiency in many services. Write for details and the new R-S Catalog No. 14-B.

R-S

VALVE DIVISION
R-S PRODUCTS CORPORATION
116 Berkley Street • Philadelphia 44, Penna.

R-S Streamlined BUTTERFLY VALVES

of the Pennsylvania Engineering Works, New Castle, Pa., was elected president of the Mahoning-Shenango Valley Engineers Society. Other officers are: Paul G. Dingledy, assistant to the manager of the Pennsylvania Power Co., vice president; Sidney L. Lockley of the Lockley Machine Co., New Castle, treasurer; L. L. Weitzel, purchasing agent of the Wean Engineering Co., Warren, Ohio, secretary.

Frank Bowers, sales engineer of the Folk Corporation, Youngstown; Thomas E. Baum, chief engineer of the Universal Sanitary Co., New Castle, and Joseph Lasky, chief engineer of the Johnson Bronze Co., New Castle, were elected members of the council.

Officers elected for the Arizona section of the American Society of Civil Engineers are Louis O. Fiscel, Florence, president to succeed John A. Carollo, Miami; W. C. O'Harra, Phoenix, first vice-president; George Grove, Tucson, second vice-president; John Gardiner, director; and L. R. Dall, secretary-treasurer.

At a meeting of the Rice Institute student chapter of the American Society of Civil Engineers at Houston, Tex., M. D. Francis was elected president; E. S. Morey, vice president; D. T. Rainey, secretary; and G. A. Peterson, treasurer.

The County Engineers Association of Ohio at its meeting in Columbus, Jan. 13, elected Wilber Terry, of Norwalk, president. Homer Bricker, of Medina, was elected treasurer.

Floyd P. Barnes of Henderson, N. C., has been elected president of the North Carolina State College chapter of the American Society of Civil Engineers. Other new officers include: F. P. Geluso, of Brooklyn, N. Y., vice president; A. C. Smith of Mooresville, N. C., secretary; and C. J. Nackos of Wilson, N. C., treasurer.

The
PHOENIX BRIDGE CO.
BRIDGES and BUILDINGS
General Office and Works
Phoenixville, Pa.
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Here's a dependable and economical "work-horse" type of dynamite which can meet practically every construction need.

DU PONT SPECIAL GELATIN is highly water-resistant and can be used with satisfactory results on wet work, or in wet or dry weather. Its plastic and cohesive qualities make it easier to use and permit denser loading. In addition, due to the high velocity of Du Pont Special Gelatin, it has a shattering action which results in excellent fragmentation, thus materially reducing wear and tear on equipment.

Put this economical, all-purpose dynamite to work on your current job. You'll like its dependable, low-cost performance. Ask any Du Pont Explosives Department representative about it, or write E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., Wilmington, Del.

LET'S ALL BACK THE ATTACK!

DU PONT EXPLOSIVES

BLASTING SUPPLIES AND ACCESSORIES

DU PONT

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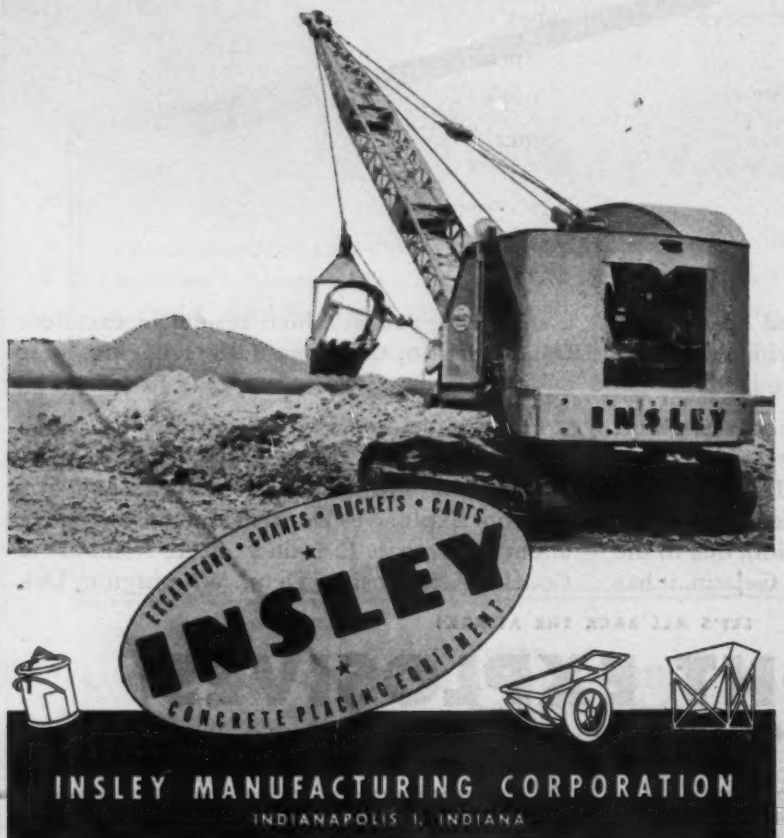
SHORTENING THE VICTORY ROAD

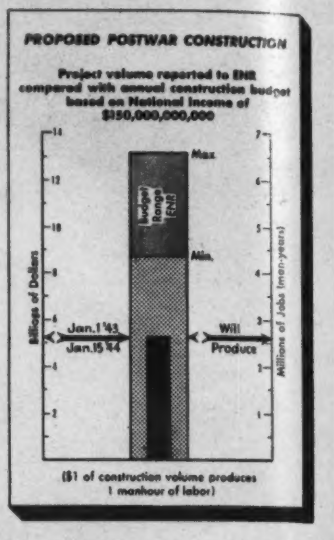
In addition to their service on the fighting front with the army engineers, seabees and the RCAF, Insley Excavators are serving with equal efficiency and valor behind the lines, preparing vital supply and communications facilities under contract to many of the allied nations.

Such is the job Insley Excavators have done for Pan-American Airways . . . gouging airports out of the muck and mire and undergrowth of the jungle . . . working day and night in penetrating dust, steaming heat or freezing cold to provide the jumping off places for war-bound transports and bombers.

Here, as in the front lines, Insley's speed, stamina and ability to work efficiently in the tight spots have demonstrated their effectiveness as a force for shortening the Victory Road. And tomorrow—when they will again be available at home—Insley Excavators will prove to you their ability to save time and money on your jobs.



POSTWAR PROJECTS


PROPOSED POSTWAR CONSTRUCTION
Project volume reported to ENR compared with annual construction budget based on National Income of $150,000,000,000
Max.
Min.
Budget Range (Full)
Billions of Dollars
Millions of Jobs (man-years)
Jan. 1 '43
Jan. 15 '44
Will Produce
($1 of construction volume produces 1 manhour of labor)

Projects proposed for postwar construction have been published in these columns since January, 1943, as they have been reported to Engineering News-Record.

The chart above shows, both in estimated dollar volume and in jobs or man-years of labor, how fast this reservoir of future work is filling up.

If you or your community are working on projects that have not yet been included in this "postwar reservoir," please send us an itemized list and description of them, including estimated cost and the names of the engineers who are at work on the plans. Then as you watch the arrows climb you will know that you and your community are contributing to the success of the NUMBER ONE JOB of preparing for peace.

Address your projects list to Manager, Business News Department, Engineering News-Record, 330 W. 42nd St., New York 18, N. Y.

MINIMUM SIZE OF PROJECTS PUBLISHED

Public Works	$25,000
Industrial Buildings	40,000
All Other Buildings	450,000

WATER SUPPLY

Conn., Colebrook — City, Metropolitan Water Bureau Dist., Hartford, dam and reservoir, Hogback Gorge, impound water west branch Farmington River, incl. tunnel through mountain to connecting Barkhamsted Reservoir. C. Saville, 1026 Main St., Hartford, engr.

Ia., Bellevue—G. J. Bittner, mayor, City Hall, water softening plant, watermains, storm sewers, $35,000.

★**La., Houma**—City, raw water supply pipeline to Mississippi River, $900,000.

La., Lafayette—City, watermains and 2 deep wells, $95,000.

Me., Lewiston—P. Wks. Dpt., City Hall, 15 m.g. reservoir, Montello Heights, $200,000.

Me., Skowhegan—State, H. C. Greenleaf, comr. Institutions, State House, Augusta, water supply sys. for women's reformatory, mains, storage, etc. Over $15,000.

★**Mich., St. Clair Shores**—A. A. Lingeman, village pres., watermains, new filtration plant, $500,000.

Minn., Anoka—C. R. Johnson, city clk., City Hall, watermains, deep well and pump, filter sys. $82,000.

Minn., DeGraff—J. M. McCarthy, city clk., City Hall, complete water and sewerage sys. $30,000.

N. Y., Lockport—City, reinforce distribution mains in south and east section of city and auxiliary pumping station, standpipe, 2 m. g., necessary connections to reinforce mains in north section of city. Chester Engineers, 210 E. Park Way, Pittsburgh, Pa., consulting engrs., and A. G. Ward, City Hall, city engr. CD 12/15—ENR 12/23.

★**N. Y., Tonawanda**—City, pump, and filtration plant. $1,000,000. State Aid Planning funds allocated.

Tenn., Nashville—T. L. Cummins, mayor, City Hall, enlarging, exten. water sys. to suburban areas. Estimates being prepared.

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